

Is Information Enough? User Responses to Seasonal Climate Forecasts in Southern Africa

Report to the World Bank, AFTE1-ENVGC.
Adaptation to Climate Change and Variability in
Sub-Saharan Africa, Phase II

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Executive Summary

Since the mid-1980s, long-lead climate forecasts have been developed and used to predict the onset of El Niño events and their impact on climate variability. Advances in the observational and theoretical understanding of El Niño and the Southern Oscillation (ENSO) have contributed to improved seasonal forecasts, with lead times of up to one year. As the ability to forecast climate variability improves, the potential social and economic applications of forecasts have become an issue of great interest. There is widespread optimism that the availability and dissemination of climate forecasts can provide much-needed information that will inevitably reduce the losses and damages attributed to climate variability. However, this study indicates that it is not only the availability of information that matters, but also the end-users capacity to act upon it.

This report discusses user responses to seasonal climate forecasts in southern Africa, with an emphasis on small-scale farmers in Namibia and Tanzania. The study examines if and how farmers received, used, and perceived the forecasts in the 1997/98 agricultural season. The report also includes a summary of a workshop on user responses to seasonal forecasts in southern Africa, organized as part of the larger project. The participants in this workshop discussed some of the bottlenecks and constraints in terms of both forecast dissemination and user responses in various branches of the agricultural sector. A comparison of case studies across southern Africa revealed that there were differences in both dissemination strategies and in the capacity to respond to extreme events. Nevertheless, it was clear that improvements in forecast dissemination coupled with improved capacity to respond to the forecasts could yield net benefits for agricultural production in southern Africa.

Case studies in Namibia and Tanzania were undertaken to capture the extent to which seasonal forecasts reached “end users” in the agricultural sector. The responses indicate both the possibilities and limitations related to climate forecasts as a means of reducing rural vulnerability to climate variability. Interviews were also conducted with national and regional agricultural and food security institutions in Namibia, Tanzania, and Zimbabwe. Institutions included government agencies, farmer organizations, research institutions, and private companies. Participation in two of the three SARCOF meetings held during the 1997/98 season provided insight into forecast development and dissemination, as well as into the emerging dialog between forecasters and users.

The surveys revealed two main trends. First, there is a need to expand dissemination. Second, there is a pressing need to improve capacity for using the forecasts. In terms of dissemination, the surveys showed that less than half of the small-scale farmers interviewed actually received the pre-season forecasts, and fewer heard the mid-season updates. Moreover, what forecasts were received were often confused with other reports stemming from the coincidental occurrence of a very strong El Niño phenomenon. One reason so few small-scale farmers received the forecasts is that they have not been directly targeted as end-users.

While dissemination efforts have clearly been inadequate, they do not appear to be as consequential as problems related to the capacity of small-scale farmers to respond to the forecasts. Unless farmers have the ability to correctly interpret the forecasts, and the capacity to take action based upon the information, the forecasts will remain underutilized. Constraints to the capacity to respond to climate forecasts lie in economic

and social structures, rather than uniquely in a lack of information. Access to credit, seeds, fertilizers, draft power, and markets shapes the ability of farmers to respond to climate information.

In the wake of the 1997/98 El Niño event, there is a need to critically reflect upon the potential benefits of seasonal climate forecasts. Responses to present-day climate variability form the cornerstone for adapting to future climate changes. In anticipation of potential changes in the frequency and/or magnitude of extreme events associated with global climate change, there is clearly a need for improved seasonal forecasts and better information dissemination. Nevertheless, the results of this study caution against a misplaced emphasis on improving the accuracy of forecasts at the expense of increasing the flexibility of farmers to adapt. Instead, the provision of information must be tied to enhanced response or adaptation options.

Climate forecasts have the potential to increase food security in southern Africa. However, to realize the full extent of potential benefits, response strategies should be strategically developed alongside dissemination strategies targeted at small-scale farmers. Moreover, this study points to a need to examine how economic changes taking place in southern Africa enhance or constrain this flexibility. Seasonal climate forecasts can serve as more than a tool for emergency management of food aid. Addressing the economic constraints to the use of seasonal climate forecasts could place farmers in a position where they could actually act upon the information. Information alone is not enough, but combined with increased attention to response strategies, seasonal climate forecasts can serve as a valuable tool for farmers in southern Africa.

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1 Introduction

Since the mid-1980s, long-lead climate forecasts have been developed and used to predict the onset of El Niño events and their impact on climate variability. Advances in the observational and theoretical understanding of El Niño and the Southern Oscillation (ENSO) have contributed to improved seasonal forecasts, with lead times of up to one year.¹ Concurrent with studies of the physical dynamics of ENSO events, the social and economic impacts of climate variability have been explored. Many of these studies have demonstrated that the impacts of climate variability differ according to the social, economic, and environmental characteristics of each region.²

As the ability to forecast climate variability improves, the potential social and economic applications of forecasts have become an issue of great interest.³ There is widespread optimism that the availability and dissemination of climate forecasts can provide much-needed information that will inevitably reduce the losses and damages attributed to climate variability. In the context of famine early warning systems and seasonal climate outlooks, there is a belief that information is the missing link between adverse weather, adaptive responses, and food security.⁴

To exploit the potential benefits of improved seasonal climate forecasting, a series of programs and projects have been initiated to improve the accuracy of forecasts and expand their dissemination. As part of this initiative, a series of Climate Outlook Forums were initiated during the 1997/98 agricultural season.⁵ One of the main objectives of these forums was to promote regional capacity to produce and apply seasonal forecasts through the creation of consensus forecasts. Another objective was to develop a better understanding of how different user groups respond to climate forecasts. An improved understanding of user needs for climate information and user responses to seasonal forecasts can contribute to the further development of seasonal climate forecasts.

Included among the Climate Outlook Fora were a series of meetings in southern Africa referred to as the Southern African Regional Climate Outlook Forum (SARCOF). The 1997/98 season represented the first year that consensus seasonal forecasts were distributed in southern Africa. This initiative coincided with one of the strongest El Niño events on record, and as a result, the media played an unusually conspicuous role in disseminating information about weather and climate. The actual impacts of the weather in southern Africa were less severe than anticipated by those who feared a replay of the 1991/92 drought. However, the anomalous season did provide an opportunity to identify

¹ National Research Council, 1996, *Learning to Predict Climate Variations Associated with El Niño and the Southern Oscillation*, Washington: National Academy Press.

² A.R. Magalhães and M.H. Glantz (ed.), 1992, *Socioeconomic Impacts of Climate Variations and Policy Responses in Brazil*, Brasilia: Fundacao Grupo Esquel Brasil.

³ P.C. Stern and W.E. Easterling, 1999, *Making Climate Forecasts Matter*, Panel on the Human Dimensions of Seasonal-to-Interannual Climate Variability, National Research Council, Washington: National Academy Press.

⁴ M. Buchanan-Smith, S. Davies and C. Petty, 1994, "Food Security: Let Them Eat Information", *IDS Bulletin*, 25(2): 69-80; Stern and Easterling, 1999.

⁵ NOAA Office of Global Programs, 1999, *An Experiment in the Application of Climate Forecasts: NOAA-OGP Activities Related to the 1997-98 El Niño Event*, Office of Global Programs, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, January 1999.

and examine issues surrounding the use and value of forecast information to farmers in southern Africa.

This report discusses user responses in southern Africa, with an emphasis on small-scale farmers in Namibia and Tanzania. The study aimed at examining if and how farmers received, used and perceived the forecasts. The report also includes a summary of a workshop on user responses in southern Africa, organized as part of the project. The participants in this workshop discussed some of the bottlenecks and constraints in terms of both forecast dissemination and user responses. The comparison of case studies across southern Africa that emerged at the workshop revealed that there were differences in both dissemination strategies and in the capacity to respond to extreme events. Nevertheless, it was clear that improvements in forecast dissemination coupled with improved capacity to respond to the forecasts would yield net benefits for agricultural production in southern Africa.

1.1 Objectives of the Study

Improvements in forecasting techniques and dissemination of information represent an emerging regional strategy for coping with climatic variations in southern Africa. In most countries of the region, some form of seasonal weather forecasts have been issued for a number of years, usually by the meteorological services, but sometimes by local “weather prophets” or other sources. The Internet has also made seasonal forecasts accessible to a growing number of individuals and organizations in southern Africa. In addition, farmers use a variety of local indicators to develop indigenous seasonal forecasts. Although these indicators are often not considered to be “scientific,” they are usually biophysically based and serve as a legitimate source of climate information.⁶

The Southern African Regional Climate Outlook Forum (SARCOF) was an outcome of the *Workshop on Reducing Climate-Related Vulnerability in Southern Africa*, held October 1-4, 1996 in Victoria Falls, Zimbabwe. SARCOF represents an effort to promote the dissemination of consistent, clear seasonal forecasts to the user community, and to minimize the confusion that arises when conflicting forecasts from various sources are heard. Other objectives of SARCOF are listed in Table 1. SARCOF involves climate modelers, meteorological services from the countries of the SADC region, and members of the national and international user communities. Users represented at the SARCOF meeting included international food aid agencies, government ministries, and commercial farmers’ organizations.

⁶ Filipe Domingos Freires Lúcio, 6 June 1999, “Use of Contemporary and Indigenous Climate Forecast Information for Farm Level Decision Making in Mozambique,” Report for the UN Office to Combat Desertification and Drought; Robinson K. Ngugi, 1999, “Use of Indigenous and Contemporary Knowledge on Climate and Drought Forecasting Information in Mwingi District, Kenya,” Report for the UN Office to Combat Desertification and Drought; Owen Shumba, 15 July 1999, “Coping With Drought: Status of Integrating Contemporary and Indigenous Climate/Drought Forecasting in Communal Areas of Zimbabwe,” Report for the UN Office to Combat Desertification and Drought.

Table 1. Objectives of SARCOF⁷

1.	To improve coordination within the climate forecasting community.
2.	To promote an ongoing dialog between forecast users and producers.
3.	To develop a consensus method to draw together existing climate products into a user-friendly Regional Climate Outlook.
4.	To evaluate regional forecast methods and assist in the development of common forecast methodologies.
5.	To address gaps in training and technical capability.
6.	To facilitate research cooperation and exchange of information.

The SARCOF process has been carried out through a series of meetings. Different forecasts are presented and discussed at the SARCOF meetings, including forecasts based on global climate models and forecasts based on local data. A “consensus” forecast is then produced for the southern African region. Three meetings were held during the 1997/98 season, which represented the first year that forecasts were disseminated in southern Africa. These included a Pre-Season Meeting; a Mid-Season Correction Forum; and a Post-Season Assessment.⁸ SARCOF has been funded through ENRICH, NOAA, IRI (funded by NOAA), the World Bank, WMO/CLIPS and SADC.

A study on user responses was undertaken to address the need to find out 1) whether the information included in the forecasts was appropriate; 2) if it was distributed to those who needed it; 3) if enough lead time was given; 4), if the information was understandable and perceived as reliable; and, more important, 5) whether the information was translated into appropriate actions. Addressing these issues can contribute to a better understanding of the extent to which forecast information can help different groups of farmers successfully adapt to climate variability.

The study presented here examines whether and how seasonal forecasts were used in the agricultural sector of southern Africa during the 1997/98 agricultural season. The study focused on small-scale farmers, as they constitute the largest group of farmers in southern Africa that can potentially benefit from forecast information. The following questions are addressed in this report:

- What is the role of forecast information in farmers’ decisions?
- What are the main constraints to optimal use of this information?
- Which other factors influence farm-level planning and decisions?

⁷ NOAA Office of Global Programs, 1999, *An Experiment in the Application of Climate Forecasts: NOAA-OGP Activities Related to the 1997-98 El Niño Event*, Office of Global Programs, National Oceanic and Atmospheric Administration, U.S. Department of Commerce, January 1999.

⁸ The Pre-Season meeting took place in Kadoma, Zimbabwe (September 8-12, 1997). The Mid-Season Correction meeting was held in Windhoek, Namibia (December 18-19, 1997). The Post-Season Assessment meeting was held in Pilanesberg, South Africa (May 12-15, 1998).

- How can the information be improved (e.g. in content or form) to help farmers maximize benefits?

1.2 Methodology

The project was carried out through two case studies in southern Africa. The two countries presented as case studies, Namibia and Tanzania, represent very different types of climates within southern Africa. Namibia is a dry country with highly variable rainfall. Droughts are common, and they have strong socioeconomic impacts. Tanzania is a mountainous country that receives ample but variable precipitation, and is vulnerable to both floods and drought. The impacts of climate variability as influenced by El Niño are considerably different for the two countries.

To gain a broad overview of some of the potential uses of climate forecasts in southern Africa, interviews were conducted with national and regional agricultural and food security institutions in Namibia, Tanzania, and Zimbabwe in April 1998. Institutions included government agencies, farmer organizations, research institutions, and private companies. Participation in two of the three SARCOF meetings held during the 1997/98 season provided insight into forecast development and dissemination, as well as into the emerging dialog between forecasters and users.

A content analysis of newspaper articles appearing prior to and during the agricultural season was carried out to establish the media context for forecast dissemination. Newspapers were surveyed during the course of fieldwork in Namibia, Tanzania, and Zimbabwe. In addition, an Internet survey was carried out based on the archives of available newspapers in southern Africa.⁹ This selective survey provided an overview of media representation of the 1997/98 El Niño season, and provided a background for analyzing the survey responses of the farmers.

The core of the study consisted of two surveys that capture the extent to which seasonal forecasts reached “end users” in the agricultural sector. The responses indicate how forecasts can be used to improve agricultural production. A pilot study with farmer interviews was conducted in Namibia and Tanzania in April, 1998. A more comprehensive survey was undertaken six months later, in October, 1998. In the second phase, adjustments were made to the questionnaires to clarify questions that were ambiguous in the pilot study. Questions regarding the forecasts for the 1998/99 season were also included in the second survey. In the case of Namibia, the second survey was carried out in different regions from the pilot study. In Tanzania, the same regions were surveyed in both studies, but households differed. The number of respondents in the first survey was 90 for Namibia and 198 for Tanzania. In the second survey, 112 were surveyed in Namibia, and 299 in Tanzania. The surveys were carried out in collaboration with the Multidisciplinary Research Centre at the University of Namibia and the Faculty of Agriculture at Sokoine University of Agriculture in Tanzania.

One goal of the project was to develop a network for research on user responses to seasonal climate forecasts in southern Africa. To achieve this, a workshop was convened

⁹ Sources for the newspaper and Internet survey include the archives of: Panafrican News Agency, ReliefWeb, Africa Online, The Namibian, Daily News (Dar es Salaam), the Express (Tanzania), and the Independent (Harare).

in Dar es Salaam, Tanzania from September 9-11, 1999. The Dar es Salaam workshop brought together a group of researchers studying various aspects of user responses to seasonal climate forecasts, and provided them with the opportunity to present, discuss, compare, and contrast research. The results of this workshop are included in the final section of this report.

1.3 Summary of Results

The debut year for a consensus climate forecasts for southern Africa coincided with the strongest El Niño event on record. As a result, the message of the forecast was frequently confused with warnings of drought that circulated in national and international media. Although the actual impacts of the 1997/98 El Niño were not as severe as many had anticipated based on media coverage, the forecasts did appear to be useful to institutions concerned with agricultural production and food security. For example, there is some evidence that the first seasonal climate forecasts were used to facilitate large-scale planning for potential food shortages, despite the fact that widespread shortages did not materialize. Although the food situation in some parts of southern Africa was critical at the end of the 1997/98 season, overall the impacts of climate variability were not severe, particularly in comparison to the 1991/92 drought.

The surveys revealed two main trends. First, there is a need to expand dissemination. Second, there is a pressing need to improve capacity for using the forecasts. In terms of dissemination, the surveys showed that less than half of the small-scale or subsistence farmers interviewed actually received the pre-season forecasts, and fewer heard the mid-season updates. While agricultural institutions, food aid organizations, and commercial farmers were among the groups that heard and in some cases heeded the forecasts, it seems clear that the majority of southern Africa's small-scale farmers did not receive the forecasts. Furthermore, it appears that the consensus forecasts disseminated after the SARCOF meetings were mixed with other messages, resulting in an atmosphere of confusion. Consequently, there is only slight evidence that the forecasts were used to alter farming practices among small-scale farmers.

Insufficient attention has been paid to small-scale farmers as end users of the forecasts. While the development of forecasts is often justified on the basis of potential benefits to small-scale farmers, they were not, as a group, directly targeted as forecast users. Instead, the forecasts were targeted at institutions concerned with national or regional food security, commercial farmers' organizations, and other institutions represented at the SARCOF meetings. Although a number of farmers did hear the forecasts on the radio, dissemination appeared to be patchy and inconsistent. As discussed at the Dar es Salaam workshop, there is a need to clarify what is meant by "end users," and to distinguish between different types of farmers when examining user responses. This means moving beyond the simple dichotomies of commercial/subsistence or commercial/communal farmers when considering how different types of farmers can benefit from the forecasts.

In general, the probabilistic seasonal forecasts developed through SARCOF performed quite well in the 1997/98 season. Nevertheless, the interpretation of the forecasts influenced their usefulness. In cases where forecasts were interpreted to mean "drought," the responses often proved to be excessive. Indeed, there is evidence that for many, responses to the forecasts were conditioned by memory of the 1991/92 El Niño event, which was devastating to much of southern Africa. In cases where the forecasts were

interpreted simply as probabilities of “below-normal, normal or above-normal rainfall,” the responses generally yielded more favorable results. Discrepancies between forecasts and rainfall conditions in some localities within a forecast region generated some criticism. The interpretation of climate forecasts thus emerged as a potential constraint to their use.

While dissemination efforts have clearly been inadequate, they do not appear to be as consequential as problems related to the capacity of small-scale farmers to respond to the forecasts. Unless farmers have the ability to correctly interpret the forecasts, and the capacity to take action based upon the information, the forecasts will remain underutilized. Constraints to the capacity to respond to climate forecasts lie in economic and social structures, rather than uniquely in a lack of information. Access to credit, seeds, fertilizers, draft power, and markets shapes the ability of farmers to respond to climate information.

Climate forecasts have the potential to increase food security in southern Africa. However, to realize the full extent of potential benefits, dissemination strategies for farmers should be strategically developed alongside response strategies. The results of this study caution against a misplaced emphasis on improving the accuracy of forecasts at the expense of increasing the flexibility of farmers to adapt. Instead, the provision of information must be tied to enhanced response or adaptation options.

2 Climate Variability in Southern Africa

2.1 The SADC Region

This study focuses on the use of climate forecasts in southern Africa, specifically Namibia and Tanzania. Participants in the Southern African Climate Outlook Forum (SARCOF) included members of the Southern African Development Community (SADC), which currently consists of fourteen countries: Angola, Botswana, Democratic Republic of Congo, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Swaziland, Tanzania, Zambia, and Zimbabwe (Figure 1). SADC was established at the Summit of Heads of State or Government on July 17, 1992, in Windhoek, Namibia. It developed from the SADCC (Southern African Development Co-ordination Conference), which was established by nine southern African states in 1979 to pursue policies aimed at economic liberation and integrated development of national economies. A major objective of SADC is to promote regional economic integration in southern Africa.¹⁰

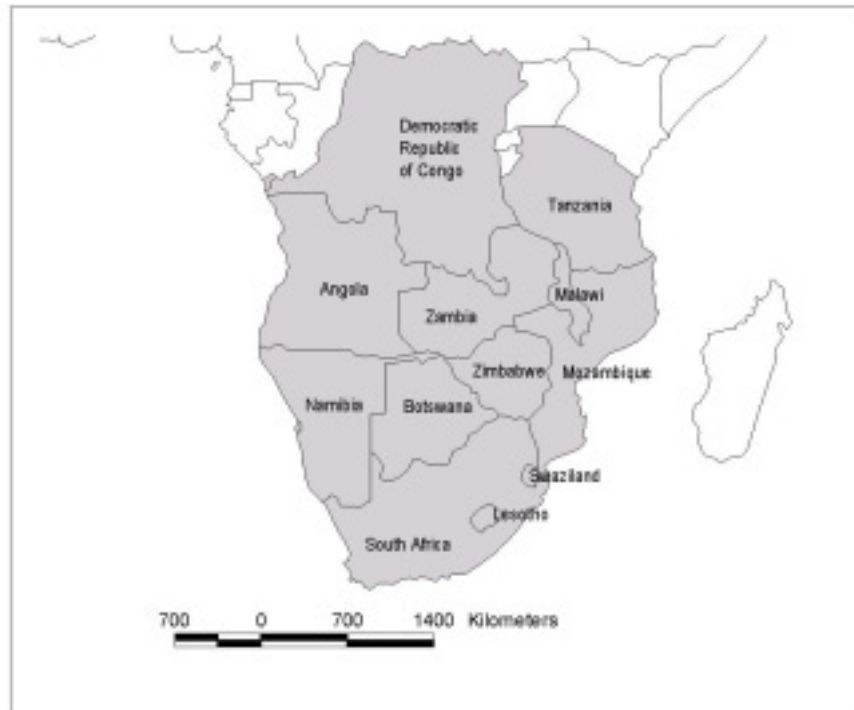


Figure 1. Map of the SADC region (excluding Mauritius and Seychelles).

Southern Africa is a region characterized by both geographic and demographic diversity. The total estimated population of the SADC region was approximately 192 million in 1998 (see Table 2). Among the fourteen SADC countries, the recently-included Republic of Congo has the largest population, with 47.8 million people. This is followed by South

¹⁰ Southern African Development Community, 1992, "SADC-Information Center Database: SADC," [Internet, WWW], ADDRESS: <http://www.sadc-online.com/sadc/index2.htm>.

Africa (42.13 million), Tanzania (31.5 million) and Mozambique (18.64 million). This contrasts with countries such as Namibia, which has a relatively low population of 1.7 million. In South Africa and Zambia, more than half of the population lives in urban areas, whereas in most of the other countries, including Tanzania and Namibia, only about 25% - 35% of the population is considered urban. Nevertheless, the urban population of SADC countries has been increasing rapidly, and rural-urban migration is expected to continue growing in the years to come.

The distribution of land area among the SADC countries varies greatly. The Republic of Congo alone constitutes about 25% of the region, and together with Angola and South Africa includes more than 50% of the total area. The share of land classified as arable also varies within the region. For example, 10% of South Africa's land is considered arable, whereas only 3% of Tanzania's land area is classified as such, compared with a mere 1% in Namibia. While countries such as Angola and Zambia benefit from a large agricultural resource base relative to the size of their populations, Malawi, Lesotho, Botswana, Swaziland, and Namibia all show signs of acute pressure on available agricultural production resources.

Table 2. Statistical data on SADC region.

<i>Country</i>	<i>Total Area (‘000 sq km)</i>	<i>Population (000)</i>	<i>GDP¹¹ (in Mill. USD)</i>
Angola	1 247.0	12 130	6 879
Botswana	582.0	1 572	5 075
D.R.C	2 345.0	47 800	1 039
Lesotho	30.0	2 225	882
Malawi	118.0	9 839	1 701
Mauritius	2.0	1 167	3 994
Mozambique	802.0	18 641	3 093
Namibia	824.0	1 584	3 059
Seychelles	0.5	79	559
South Africa	1 221.0	42 131	103 623
Swaziland	17.0	966	1 262
Tanzania	945.0	31 500	7 526
Zambia	753.0	10 100	2 808
Zimbabwe	391.0	12 685	6 399
SADC	9 278.0	192 418	157 902

Source: Central Statistics Offices of Member States and SADC Secretary.

The regional economy of southern Africa is dominated by the contribution of South Africa, which alone accounts for more than three-quarters of regional gross domestic product (GDP). Although the economic structure of the 14 countries is diverse in terms of human and natural resources, there are a number of important similarities. Historically, many of these countries have experienced the same problems and challenges, including colonialism, wars, political instability, drought, and economic crises leading to fluctuations in export commodity prices and declines in the capacity to import. As a

¹¹ At current prices (1999)

consequence of economic instability, many of the countries in southern Africa were obliged to adopt severely deflationary structural adjustment programs in the 1980s. Income inequalities are high within each country, and development is unevenly distributed.

2.2 Climate and Climate Variability in Southern Africa

Variability is an inherent characteristic of the climate of southern Africa. The climate of the region can be defined as predominantly semi-arid, with high intra- and inter-annual rainfall variability.¹² Average annual rainfall in southern Africa is just under 700 mm. There are, however, large spatial variations, with some desert areas receiving less than 200 mm and some highland areas receiving over 2000 mm.¹⁵ In general, rainfall increases towards the equator, and is most scant in the south and west. Local exceptions occur, and there are both wet and dry areas within any particular climate zone.

The rainy season in southern Africa generally extends from October/November to April, reaching a peak between December and February. Some areas in southern Africa receive rainfall year-round, and some parts experience two rainy seasons. For example, northern Tanzania experiences both a short rainy season and a long rainy season. Most of southern Africa receives more than 75% of its mean annual precipitation during the rainy season, and some parts receive as much as 90% during this period. Significant precipitation is unusual after mid-May.

The distribution of rainfall within the six-month rainy season is quite variable. It depends on the dynamics between tropical and mid-latitude weather systems, as well as convective variability.¹⁴ The movement of monsoon circulations is a critical factor determining the beginning of the rainy season. The onset of the rains, which in many places is considered to be the single most important event of the year, occurs suddenly, often within a 48-hour period.¹⁵ In any year with "average" rainfall, there are dispersed wet and dry periods. The season might start out with abundant rains, but then become dry in the latter part of the season. Other years may be characterized by a poor start to the rainy season, compensated by sufficient rains later in the season. For farmers in southern Africa, the timing of the rainfall is critical in determining the success or failure of crops.

Southern Africa experiences high interannual variability, which is linked to global circulation trends that affect monsoon circulations. The El Niño phenomenon, described in the following section, is one factor that influences interannual variability in southern Africa. Although droughts, and to a lesser extent floods, are characteristic of the region's climate, recent episodes of extreme weather events have had large negative effects on the welfare of southern African people.

¹² S.J. Manson, 1996, "Regional Manifestations of Climate Variability in Southern Africa," in M. Stewart, C.E. Clark, B. Thompson, S. Lancaster and L. Manco (ed.), 1-4 October 1996, Workshop on Reducing Climate-Related Vulnerability in Southern Africa, Victoria Falls, Zimbabwe, pp. 19-25; B.J. Garanganga, 1998, "Review of Southern Africa Climate Variability," in Mike Harrison (ed.), 31 March 1998, First Report of the Enrich Southern Africa Regional Climate Outlook Forum to the European Commission, [Internet, WWW], ADDRESS: http://151.170.240.7/sec5/NWP_seasonal/NWP_pef_ensarcof/report1/index.html

¹³ Garanganga, 1998.

¹⁴ Garanganga, 1998.

¹⁵ Garanganga, 1998.

2.3 El Niño and its Impacts on Southern Africa

El Niño is the term used to describe the extensive warming of the upper ocean in the tropical eastern Pacific. It refers to the warm phase of the El Niño-Southern Oscillation (ENSO) phenomenon that takes place in the tropical Pacific. This ocean-atmosphere phenomenon occurs when the air pressure gradient between the central and western parts of the Pacific Ocean weakens. This results in a dramatic rise in ocean temperatures, coupled with an increase in rainfall in the eastern Pacific (Peru) and a decrease in rainfall in the western Pacific (Indonesia and Australia). ENSO events occur periodically, every two to seven years. A typical ENSO cycle lasts for three or more seasons, developing through several phases, from the warming of the oceans to the return to normal temperatures, followed by a vigorous circulation known as La Niña. Although every ENSO event is different in terms of its magnitude and duration, the ability to predict the occurrence of El Niño has improved tremendously over the last decade.

Changes in the location and concentration of atmospheric and oceanic heat associated with ENSO alter atmospheric circulation and lead to changes in climate patterns around the globe. Sea surface temperatures in the Atlantic and Indian Oceans are modified by ENSO, and they then influence the climate in adjacent continental regions.¹⁶ Although the impacts of El Niño are global, most attention has been given to the regional impacts of the phenomenon.

In southern Africa, El Niño years are typically dry in the south and south-western part of the region, and wet in the eastern parts. Preliminary remote sensing studies using a vegetation index for southern Africa show that there are at least two different forms of El Niño impacts in southern Africa.¹⁷ The first type is a moving event that begins with drought in northern Namibia in early January. The core area of impact then shifts to Botswana, northern Zimbabwe, southern Zambia, and northwest Mozambique. Type I events reach southern Malawi in the late summer or early autumn. This type of event occurred in 1987 and 1995. Type II ENSO events, in contrast, do not move but instead grow from a core area near the borders of southern Zimbabwe, southern Mozambique and northeastern South Africa. These events are considered to be more severe, and describe the 1983 and 1992 El Niño events.

Climatologists and meteorologists have been debating the role of El Niño as a driving force behind climate variability in Africa. It is estimated that El Niño accounts for somewhere between 30 to 35% of climate variability.¹⁸ In any case, it is important to emphasize that El Niño is only one factor influencing climate variability in southern Africa.

¹⁶ C. Eakin, July 1999, El Niño – Southern Oscillation (ENSO) Home Page, [Internet, WWW], ADDRESS: www.ogp.noaa.gov/enso/.

¹⁷ Clark Labs ENSO Monitor, 1998, “The Geography of ENSO in Southern Africa,” Vol. 1, No. 9. [Internet, WWW], ADDRESS: <http://www.clarklabs.org/10applic/assaf1/monitfront.htm>.

¹⁸ Amos Makarau and Mark Jury, 1997, “Predictability of Zimbabwe Summer Rainfall,” *International Journal of Climatology*, 17(3):1421.

3 The 1997/98 Season in Southern Africa

3.1 The Kadoma Outlook

The first SARCOF meeting was held in Kadoma, Zimbabwe, from September 8-12, 1997. This meeting brought together Meteorological Services from eleven SADC countries, as well as scientists from international research institutes and universities. During the course of the meeting, the state of the global climate system was reviewed, and its implications for southern Africa were considered. The El Niño event taking place in the tropical Pacific Ocean was considered an important factor influencing the regional climate. Past El Niño events (eg. 1982/83, 1991/92, and 1994/95) had resulted in low rainfall over much of southern Africa. This factor and others were assessed using coupled ocean-atmosphere models, physically based statistical models, and expert interpretation.

The Kadoma Outlook divided the 1997/98 season into two periods: The first period covered October, November and December (OND), and the second covered December, January, February and March (DJFM).¹⁹ The consensus forecast consisted of probability distributions indicating the likelihood of below-normal, normal, or above-normal rainfall for different sub-regions of southern Africa. Information accompanying the Outlook explains how the probabilities for each region are calculated, based upon observed climate data from 1961 to 1990. It also emphasizes that the boundaries between the sub-regions should be considered as transition zones, rather than absolute boundaries.²⁰

During the first period (OND), above-normal rainfall was forecast for northern Tanzania, corresponding to the short rains or *vuli* period. The extreme southern tip of South Africa was also expected to experience above-normal rainfall. In contrast, Mauritius was expected to receive below-normal rainfall. Excluding these three cases, rainfall was expected to more or less normal throughout most of the region during the first period.

The second period (DJFM) represents the main rainy season for most of southern Africa. The Kadoma Outlook forecasted normal- to above-normal rainfall in the northeastern regions of southern Africa. Below-normal rainfall was forecast for regions to the south, with significantly lower rainfall over South Africa, southern Mozambique, Lesotho and Swaziland. The northern boundary for this region was not clearly defined. Mauritius was expected to experience above-normal rainfall in the DJFM period.

The models discussed at the Kadoma meeting demonstrated less agreement for some areas of southern Africa, including Malawi, southwestern Zambia and northern Namibia for the DJFM period. This was reflected in ambiguous probabilities in the Kadoma Outlook.

¹⁹ NOAA's Office of Global Programs, 1999, "Statement From the Southern African Regional Climate Outlook Forum," [Internet, WWW], ADDRESS: http://www.ogp.noaa.gov/enso/september_forum.html.

²⁰ NOAA, 1999.

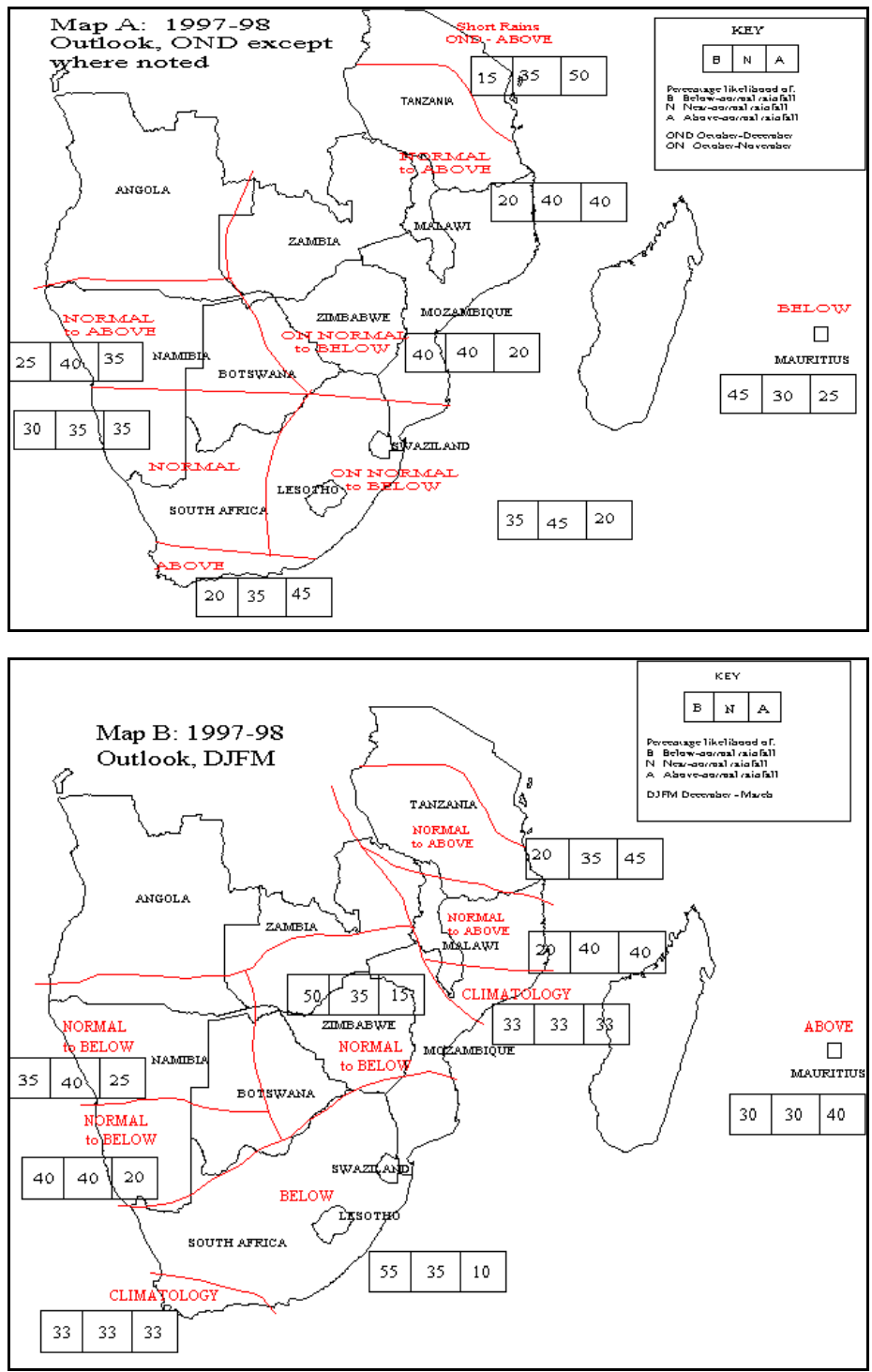


Figure 2. SARCOF pre-season forecasts, OND and DJFM, Kadoma meeting.

3.2 The Windhoek Mid-season Correction

SARCOF reconvened in Windhoek, Namibia from December 18-19, 1997 to formulate a consensus forecast for southern Africa for the period of January, February and March (JFM), 1998. The purpose of this mid-season meeting was to update the information provided by the Kadoma forum.

The mid-season assessment began with a consensus agreement that the current El Niño would remain influential over the JFM period.²¹ This period coincides with a large part of the rainy season for most of southern Africa. Exceptions to this include the northern and eastern parts of Tanzania, and the far south-western part of South Africa, where rainfall occurs in later months as well.

The update identified above-normal rains for northern and eastern Tanzania prior to the onset of the long rains (*masika*) in March. The forecasts did not cover March for this region. Near-normal rainfall was expected over the south-western part of Tanzania, northern and eastern Zambia, central and northern Malawi, and northern Mozambique. Near-normal rainfall was also expected over north-western Zambia and the far north-western part of Namibia. Near-normal to above-normal rainfall was expected for Mauritius and the south-western tip of South Africa.

The forum confirmed an increased probability of below-normal rainfall in JFM for the rest of continental southern Africa. Below-normal to near-normal rainfall was expected in northern Namibia and in the southern half of Zambia. According to the outlook, there was a strong probability of below-normal rainfall in central and southern Namibia, most of Botswana, Lesotho and much of South Africa.

The mid-season forecast from the Windhoek meeting predicted normal rainfall in the extreme north-western part of Namibia, below to normal for the remainder of the north-western part of Namibia, and below for the rest of the country, including the eastern part of the Caprivi strip. The trends in the forecast were thus the same as the Kadoma Outlook (which also included December), but the message was stronger (with the exception of the north-western area).

The forum had difficulty reaching a consensus as to how far east the strong indication of below-normal rainfall extended into northeastern South Africa, Swaziland, southern Mozambique, southern Malawi, and Zimbabwe. In some of the models, the strong risk of below-normal rainfall for the eastern regions was somewhat weakened from the Kadoma Outlook.

²¹ NOAA's Office of Global Programs, 1999, "Statement From the Southern African Regional Climate Outlook Forum," [Internet, WWW], ADDRESS: http://www.ogp.noaa.gov/enso/december_forum.html.

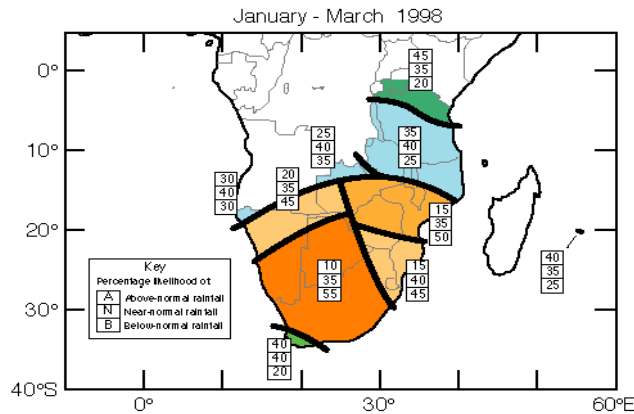


Figure 3. SARCof mid-season correction forecast for southern Africa, JFM, Windhoek meeting.

3.3 Climate Observations and Forecast Assessments

The southwestern part of southern Africa including Zimbabwe, South Africa and Namibia did receive below average rainfall and experienced drought conditions. In contrast, the eastern part of the region, including many parts of Tanzania, experienced heavy flooding. In Tanzania, the previous El Niño event was associated with dry conditions, thus the floods were quite unexpected. Floods generated larger direct economic losses in comparison to drought because of the enormous destruction of infrastructure.

Namibia experienced a close to normal situation up to January (beginning, middle or end depending on region). After this, very little rainfall occurred, resulting in poor crop yields and little water flow into reservoirs.²² The Weather Bureau evaluated forecast accuracy for both periods, OND (October-December) and JFM (January-March).²³ Actual rainfall was compared to the tercile limits and the outlook. In the case of the JFM forecasts, 47 out of 55 climate stations were correctly forecasted (Figure 4). The forecast was too low at five of the stations, and much too low at three of the stations. In the figure, a gridded square represents stations where observed rainfall was greater than the SARCof forecast (with the extreme cases emphasized as filled squares), and a circle indicates agreement between the observed rainfall and the SARCof forecast. In general, the forecasts were correct in

²² P. Hutchinson, 1998, "Namibian Report," in Mike Harrison (ed.), 30 September 1998, Second Report of the Enrich Southern Africa Regional Climate Outlook Forum to the European Commission, [Internet, WWW], ADDRESS: http://www.met-office.gov.uk/sec5/NWP_seasonal/NWP_pef_ensarcof/r.../projassess2.htm.

²³ Namibia Meteorological Services, 1998a, "10-day Rainfall Bulletin," Supplement: Assessment of the SARCof Outlook for October, November and December 1997; Namibia Meteorological Services, 1998b, 1998, "10-day Rainfall Bulletin," Supplement: Assessment of the SARCof Outlook for January, February and March 1998; Neil Ward, Leonard S. Uganai and Bradwell J. Garanga, 1998, "Verification of the 1997/98 ENSARCOF seasonal Rainfall Outlook: Issues, Methodology and Results," in Mike Harrison (ed.), 30 September 1998, Second Report of the Enrich Southern Africa Regional Climate Outlook Forum to the European Commission, [Internet, WWW], ADDRESS: http://www.met-office.gov.uk/sec5/NWP_seasonal/NWP_pef_ensarcof/r.../projassess2.htm.

the north, and generally correct in the south. The forecast outlook was considerably closer to the outcome than a no-skill forecast (based on an equal probability of below, normal, and above). Some bias was observed in the south, with 33% of stations recording more rainfall than forecasted, and none less than forecast.²⁴

In Tanzania, some stations along the northern coast recorded the highest ever monthly and maximum 24-hour rainfall in the month of October. Most of the records were in excess of 600% of normal. Above normal rainfall continued in the northern part of the country during November, and most of the country received above normal rainfall in December. The southern part of Tanzania received normal rainfall during January and February. The northern part, however, did not get the dry spell that normally occurs during that time. In general, rainfall patterns agreed well with the SARCOF forecasts for October to December, whereas forecast performance for January-March 1998 was less impressive.²⁵

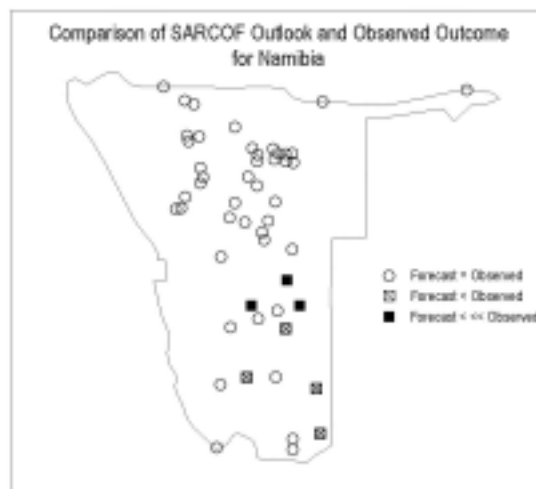


Figure 4. Evaluation of 1997/98 forecasts, January-March.

Source: Namibia Meteorological Services.

Post-forecast assessments suggest that the SARCOF outlooks for Namibia and Tanzania were generally correct. To assess whether the forecasts were received and translated into actions at the farm-level, surveys were carried out among small-scale farmers in both countries. The surveys did not specifically refer to the SARCOF forecasts because the latter are disseminated by national meteorological services, and are not presented distinctly as SARCOF forecasts.

²⁴ Namibia Meteorological Service, 1998b.

²⁵ Emmanuel J. Mutoni, 1998, "Review of Rainfall in Tanzania for the Period October 1997 to March 1998," in Mike Harrison (ed.), 30 September 1998, Second Report of the Enrich Southern Africa Regional Climate Outlook Forum to the European Commission.

4 Case Study I: Farmer Responses to Forecasts in Namibia

Despite being the driest country in Sub-Saharan Africa, Namibia is heavily dependent on agriculture. A majority of the population of Namibia consists of subsistence farmers who rely directly on agriculture and livestock herding for food consumption. Commercial farmers also produce maize, wheat and sunflowers for national consumption, and livestock for export. Yet rainfall is low, unreliable and irregular in most parts of the country. Climate forecasts can potentially benefit farmers by enabling them to prepare for both dry years and exceptional years with abundant rainfall. To realize the benefits of forecasts, they must be received and used by farmers.



Figure 5. Map of Namibia.

4.1 Namibia

Namibia is located on the southwestern coast of Africa, bordering South Africa, Botswana, Zimbabwe, Zambia and Angola (Figure 5). As one of the last colonies in Africa, Namibia gained independence from South Africa in 1990. The country has a population of about 1.7 million, of which 70% lives in rural areas. The population growth rate in Namibia is about 3%, one of the highest in southern Africa. The capital, Windhoek, had an estimated population of about 182,000 in 1995.

The country covers an area of 825,418 km², and has an overall population density of only 2 persons per km². In fact, large parts of the country are either uninhabited or sustain a very small population. Namibia is divided into 13 administrative regions. The northern and northeastern regions of Omusati, Oshana, Ohangwena, Oshikoto, Okavango, and

Caprivi have the high population densities. Covering less than 15% of the country, these regions are home to more than 60% of the population.²⁶

Average per capita income was estimated at about USD 3,700 in 1996, but there are large variations within the population. The top 1% in terms of income has a total annual income that exceeds the total income of the bottom 50%. In 1994, approximately 47% of the population were classified as poor (defined as households where more than 60% of the value of consumption is spent on food). Of these, approximately 13% were classified as severely poor.²⁷

Directly or indirectly, agriculture (including livestock) provides a living for 90% of the population in Namibia.²⁸ However, only 1% of the land area is considered arable, and only 0.9% of the total land area is irrigated. The amount of arable land per capita is only 0.44 ha. Yet despite environmental constraints, 85% of the country is used for agricultural purposes. Agriculture contributes to 14% of GDP and to 15.3% of total exports from Namibia. Only the mining sector is more important in terms of GDP and export value. Export products from the agricultural sector consist primarily of beef cattle and karakul sheep. Main domestic food crops include millet, maize, and wheat. Cereals, produced mainly in the north, contribute to 60% of the staple foods in total caloric intake.

Livestock farming dominates the agricultural sector in Namibia, with sheep and goats in the south and cattle in the north and center. The average size of commercial farms in the south is 7500 ha and in the north 4500 ha. Crop production plays a minor role in terms of GDP contribution, but employs more people than livestock farming. There are between 120,000 and 150,000 subsistence farm units in Namibia,²⁹ with farms averaging 2-4 ha in size. Namibia currently imports more than half of its domestic grain requirements, mainly in the form of maize and wheat. The largest source of imports is South Africa, which is also destination for the major share of exports from the agricultural sector in Namibia.

Namibia's agricultural sector can be roughly divided into two categories, export-oriented and capital-intensive "commercial" farming, and labor-intensive subsistence or sub-subsistence "communal" farming. Forty-four percent of the total land area is used by the commercial farming sector, 41% by the communal farming sector, and the remaining 15% consists of diamond areas, nature reserves and urban areas.³⁰ Commercial crop production is largely confined to the "Maize Triangle" between Grootfontein, Otavi and

²⁶ National Planning Commission (NPC), 1992, "1991 Population and Housing Census," *Preliminary Report*, NPC, Central Statistics Office, cited by Steven Devereux and Trine Naeraa, 1993, "Drought and Entitlement Decline in Namibian Agriculture," *Social Sciences Division Discussion Paper 3*, p. 9.

²⁷ NPC, 1997.

²⁸ W. Werner, 1993, "A Brief History of Land Dispossession in Namibia," *Journal of Southern African Studies* 19(1): 135-146, quoted in Donna Pankhurst, 1995, "Towards Reconciliation of the Land Issues in Namibia: Identifying the Possible, Assessing the Probable," *Development and Change* Vol. 26 (1995), p. 551-585.

²⁹ Statistisches Bundesamt, 1992, "Country Profile Namibia 1992", Metzler-Poeschel Verlag, Stuttgart, cited by H. Kolberg, 1995, "Country Report for Namibia," International Conference and Programme for Plant Genetic Resources, [Internet, WWW], ADDRESS: <http://web.icppgr.fao.org/pdf/namibia.pdf>.

³⁰ Kolberg, 1995.

Tsumeb in northern Namibia. In addition to maize, commercial farmers grow sunflowers, cotton and drybeans.³¹

Communal farmers are mainly subsistence-based, selling their surplus crops in good years. Farming in many cases provides a significant share of the income, but alternative sources are also common.³² Input use on communal farms is generally low. Communal areas make up 10% of the agricultural contribution to GDP. Communal crop production areas are mainly found in the northern provinces of Omusati, Oshana, Ohangwena, Oshikoto and Okavango, and in the Caprivi Strip in the northeast. Most millet-growing households are located in the northern provinces. Maize is produced in the northeastern communal region of Caprivi.

4.2 Climate

Namibia is the driest country in Sub-Saharan Africa. It has a subtropical climate, with an average daily temperature of 25°C. Most of the country is semi-arid or arid. Mean annual rainfall in Namibia is in the range of 250 to 500 mm. The influx of moisture from the south Atlantic is reduced by the high-pressure systems associated with the cold Benguela Current along the coast.³³ There are few perennial rivers in Namibia, and most of these are located along borders with neighboring countries. Evaporation exceeds rainfall by a factor of 5 to 10 for most of the country, and only 2% of the rainfall is available as runoff. A mere one percent of the rainfall goes to the recharge of groundwater resources.³⁴

This rainfall in Namibia is markedly seasonal. Most rain normally occurs between the end of December and the middle of April, whereas virtually no rain falls between May and October. Rainfall is also highly variable from year to year. Consequently, mean values may be misleading because they refer to averages over large areas with significant variations from one year to another.

Although Namibia is characterized by a naturally arid environment, there are regional differences. The regions located in northeast Namibia, including Caprivi and Okavango, receive more than 500 mm of rain annually. However, these regions represent only 8% of the country. Even though these areas are relatively moist, rainfall variability is high and the temperatures reaching 37-38°C in the summer create high evaporative demands for water.

4.3 SARCOF Forecasts for Namibia

The SARCOF forecasts described in Section 3 were disseminated by the Namibian Meteorological Service. However, climate information was also distributed by various other sources in relation to the well-publicized El Niño event. To establish the context under which the forecasts were distributed and possibly received by small-scale farmers,

³¹ Steven Devereux and Trine Naeraa, 1993, "Drought and Entitlement Decline in Namibian Agriculture," *Social Sciences Division Discussion Paper 3*, p. 9.

³² Bruce Frayne, April 1997, "Namibia Case Study Community Drought Mitigation Strategies," for the Community Drought Mitigation Project.

³³ Department of Water Affairs, 1995, "General Hydrological Conditions and Characteristics of Surface Water Schemes in Namibia," report by Hydrology Division, Ministry of Agriculture, Water and Rural Development, Department of Water Affairs, May 1995.

³⁴ Department of Water Affairs, 1995.

interviews with government officials were combined with a survey of newspapers. Below is a brief reconstruction of the flow of information surrounding El Niño and the 1997/98 season for agricultural production.

Among government officials, many cite a meeting held by USAID in August or September as the first exposure to forecasts of a strong El Niño event. The possibility of a strong El Niño is mentioned in *The Namibian* on September 9, 1997 in connection with a regional meeting in Gaborone.³⁵ According to the same news story, a statement was issued the previous week by SADC, warning of reduced crops in the region due to El Niño.

The Ministry of Agriculture was informed of the outcome of the SARCOF meeting in Kadoma (which was held September 12-15) on September 19. The prevailing food security situation was assessed and found to be satisfactory, and no specific actions appear to have been taken at that time.

Once the SARCOF forecasts were distributed, the government policy was to leave it to the end users to decide how to respond. For political reasons, officials did not want to cause fear or panic among farmers. More important, the Government would face problems if forecasts were wrong and “official” advice had been followed. At that time, a new drought policy was under development.³⁶ Under the new policy, households would have to show that they had taken actions to mitigate drought consequences (such as selling livestock) before they could get drought relief.

The updated SARCOF forecast for January-March (developed at the Windhoek meeting) was printed in *Windhoek Observer* on January 3, 1998. Ten days later, *The Namibian* reported that “the good rainfall conditions are not going to last,” referring to a bulletin from the Namibian Meteorological Service.³⁷ According to this bulletin, the outlook for January to March indicated a below normal year for the entire country south of a line from Swakopmund to Katima Mulilo (in Caprivi), though Tsumkwe.

Several reports emphasized that although the cumulative rainfall had been fairly good until mid-January, the spatial and temporal rainfall distribution was considered poor. The good rains in October were considered to be offset by a lack of significant rain in November.³⁸ Most of the country, except Karas, Okavango and Caprivi, received above-average rainfall until mid-January. However, after that, the rainy season deteriorated, and dry conditions prevailed. By March, the season was reported to be a failure.³⁹ Comparisons were made between 1998 and two serious drought years, 1933 and 1946.⁴⁰

While the updated SARCOF forecast predicted dry conditions for most of Namibia from January to March, in January there were reports of severe damages in the Caprivi region due to *flooding*. The flooding was sudden and took people by surprise. Thirteen people

³⁵ 9 September 1997, “El Nino whips up worries among regional experts,” *The Namibian*, pp. 5.

³⁶ A. Thomson, P. Jenden and E. Clay, 1998, “Information, Risk and Drought Preparedness: Responses to the 1997 El Niño Event,” Research Report, DFID, ESCOR No. AG1215, May 1998, SOS Sahel: London.

³⁷ Hugh Ellis, 13 January 1998, “Rain Prospects Remain ‘Poor’,” *The Namibian*,

³⁸ 3 January 1998, “Wet Xmas revives Triangle’s farmers,” *Windhoek Observer*, pp. 10.

³⁹ 7 March 1998, “It Looks Bad,” *Windhoek Observer*; Christof Maletsky, 23 March 1998, “Drought Hits Progress: Nujoma Warns of New Emergency,” *The Namibian*, pp. 1-2.

⁴⁰ 7 March 1998, “It Looks Bad,” *Windhoek Observer*.

The three communal areas surveyed in this study are located in the densely populated north. Of the three regions, Ohangwena has the highest population and the greatest population density. Okavango has almost four times the area of Ohangwena, yet has only half the population size. Caprivi has a population size similar to Okavango, but concentrated on less than half of the land area (Table 3).

Table 3. Population data for study regions. ⁴⁴

Study Regions in Namibia			
<i>Region</i>	<i>Area</i>	<i>Population</i>	<i>Pop. Density</i>
Caprivi	18,530	107,489	5.80
Okavango	42,771	110,313	2.58
Ohangwena	10,029	230,023	22.94

Source: 1996 Intercensal Survey.

Rainfall is low and highly variable in Ohangwena, and drought is common. Main economic activities are household-based livestock and crop production. Okavango and Caprivi contain a significant quantity of good lands, and receive relatively high levels of rainfall.⁴⁵ Ohangwena, Okavango, Caprivi, and other neighboring communal regions are relatively homogenous in terms of social structure and economic activity.⁴⁶ General characteristics include:

- The majority of cropping areas are less than 2 ha. Staple food crops include millet (mahangu), sorghum and maize. Secondary food sources include fruits, nuts, meat and milk. Small areas are under irrigation, where farmers grow various crops (maize, vegetables, and wheat).
- Common livestock species include cattle, goats and donkeys. However, less than 50% of households have livestock. More than 30% of households do not have access to draft power (oxen and tractors).
- Land is generally under communal ownership and land tenure is controlled by traditional community leadership structures.
- Literacy levels are low; there is low access to health services, and infant and maternal mortality rates are high.
- Many rural households get economic support from a household member in non-rural areas or from state pensions.

⁴⁴ Namibia Ministry of Health and Social Services, Population/Demographic Data Downloads, [Internet, WWW], ADDRESS: <http://www.healthforall.net/popfiles1.htm>.

⁴⁵ Donna Pankhurst, 1995, "Towards Reconciliation of the Land Issues in Namibia: Identifying the Possible, Assessing the Probable," *Development and Change* Vol. 26 (1995), pp. 551-585.

⁴⁶ Bruce Frayne, April 1997, "Namibia Case Study Community Drought Mitigation Strategies," Report for the Community Drought Mitigation Project, [Internet, WWW], ADDRESS: <http://161.132.66.6/Publicaciones/libros/11/11index.htm>.

The results included in this report were compiled from both the pilot study and the second survey. However, the results of the two surveys are presented by region, rather than according to the date of the survey. Some distinctions between Ohangwena and the other two regions are made because the two surveys were carried out using slightly different questionnaires.

The two surveys in Namibia included 90 respondents in Ohangwena, 56 in Caprivi, and 56 in Okavango. All of the respondents in the two surveys were small-scale (communal) farmers. The majority (66%) of those surveyed in Ohangwena were men, with an average age of 63. In Caprivi and Okavango the share of female participants was slightly higher (45%), and the average age was lower (45 years).

The average farm size differed among the three regions, as did the average household size. In Ohangwena the average farm size was below 2 ha, with each farm supporting a household of more than 7 members. Average farm size in Okavango was 2.6 hectares, and the average household size was 9 persons. Caprivi had the largest average farm size (8.9 hectares) and the smallest average household size (6 persons). Most of the farmers in Ohangwena grow millet (*mahangu*) and sorghum (99% and 96% of the respondents, respectively). A smaller percentage grows maize (19%) and some farmers cultivate groundnuts (9%). Maize production is far more common in Caprivi and Okavango (92% and 82%). In Okavango, millet was still the most cultivated crop, planted by 93% of respondents, whereas sorghum and groundnuts were less common (34% and 11%, respectively). In Caprivi, sorghum was cultivated by 64% of the respondents, followed by millet (38%) and groundnuts (5%).

The farmers in the three study regions are generally subsistence farmers. The sale of surplus harvest is uncommon, especially in Okavango and Ohangwena. Only the most well-off farmers are occasionally able to bring surplus crop to the market and generate income. In Caprivi, more than 40% of the farmers generated some income from agricultural production. Among these farmers, the average income was NAD 2342, or approximately USD 350. Table 4 presents a comparison of marketing patterns between Caprivi and Okavango for the three main crops.

Table 4. Households selling surplus harvest and amount sold as percentage of production.

Crops	Caprivi		Okavango	
	% engaged in market activities (persons)	Average share of production marketed (%)	% engaged in market activities (persons)	Average share of production marketed
Maize	36 (20)	28	4 (2)	30
Sorghum	14 (8)	25	2 (1)	40
Millet	11 (6)	12	4 (2)	25

Although some farmers from Caprivi generate income from crop cultivation, many have additional means of income. This multi-income strategy primarily involves income

generated from livestock, which is part of the agricultural sector (64% of respondents). Animal husbandry was also common in Okavango (46%), and to a lesser extent in Ohangwena (28%). The distribution of additional income is presented in Figure 7. The category “other” includes government and family transfers. In all regions, it was common to receive old-age pensions or allowances from other family members or relatives. This was found to be particularly true in Ohangwena, where the age of respondents was relatively high.

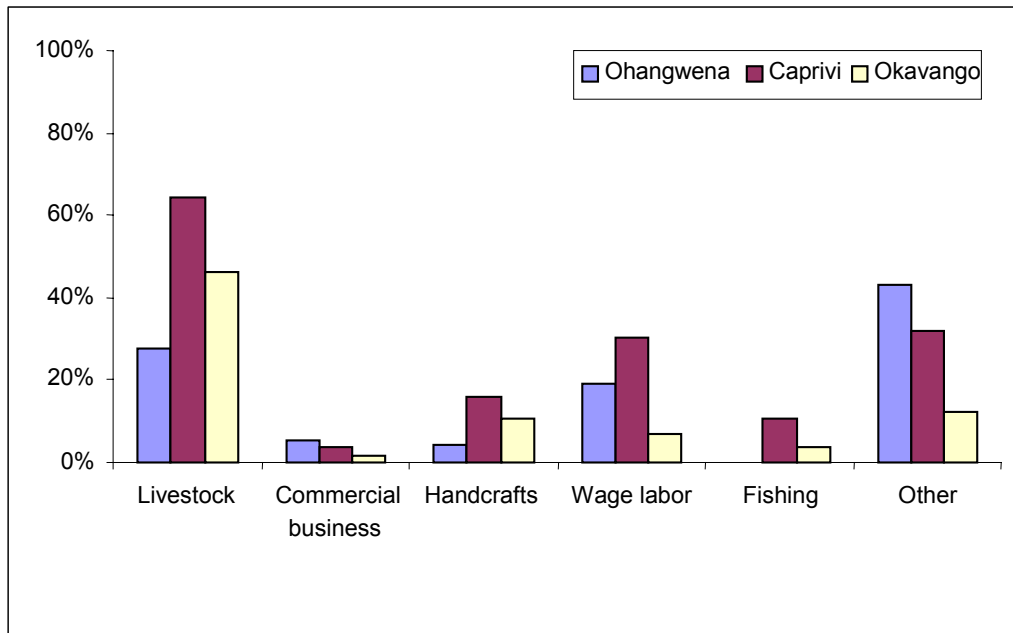


Figure 7. Additional sources of income.

4.5 Perceptions of Climate Variability

Before responding to questions about climate forecasts, farmers were asked to describe the characteristics of the 1997/98 season in comparison to previous years. The purpose of this question was to explore what different farmers considered to be “normal” and “extreme” years in terms of the weather. “Normal” is a relative and subjective term, and often farmers consider an unusually good year to be the “normal” situation. Not surprisingly, the majority (88%) of the respondents perceived the weather to be “not normal” during the 1997/98 season.

The farmers were also asked to compare the 1997/98 season with what they considered to be the most recent year with extreme weather. Most of the farmers in Caprivi and Okavango considered 1996 to be the most recent extreme year, whereas farmers in Ohangwena felt that 1991/92 was the most extreme year. The 1991/92 season corresponded to a strong El Niño year, which had severe impacts on agriculture in southern Africa. In relation to 1991/92, most farmers in Ohangwena felt that the 1997/98 season was better. This is reflected in some of the comments: “This year we will have

some millet. Not like in 1992, when we really suffered from food shortage” and “[in 1992] most animals died, but this year I don’t think the same will happen.”

The role of local indicators is important in determining the value of “external” forecasts such as those issued by SARCOF. Almost 50% of the farmers said that they did notice early indications of a dry season ahead. As listed in Table 9, rising temperatures was one of the most common signals of abnormal weather, especially in Caprivi and Okavango. Observation of cloud formations and increased wind speed were also important natural indicators of dry conditions in the upcoming season. The farmers from Ohangwena mentioned that they harvested a lot of traditional fruits (from palms). In traditional knowledge, the increased availability indicates a dry season because fruits compensate for a bad crop season.

Table 5. Early signs of an abnormal season.

Signs	Respondents
High temperatures	28 %
Windier	12 %
Clouds in the sky	11 %
Vegetation turning green	3 %
Cooler	3 %
Amount of tree-fruits	20 %
Various tree-fruits are smaller	5 %

4.6 Dissemination of the Forecasts

One of the main objectives of the survey was to find out whether farmers received the forecasts, and if so, how. As mentioned earlier, it is not possible to isolate the SARCOF forecasts from other weather-related information that farmers may receive, as both types of forecasts were distributed through the Namibian Meteorological Service. Farmers were asked if they had received any pre-season weather forecasts for the 1997/98 season. If so, they were asked to specify the month and year, as well as the source of the information. They were later asked similar questions about the mid-season forecasts.

Table 6. Share of farmers receiving the pre-season forecasts.

Region	% of farmers receiving the pre-season forecasts (persons)
Ohangwena	56 % (50)
Caprivi	32 % (18)
Okavango	16 % (9)

More than half of the farmers interviewed in the pilot survey (56%) had received a pre-season forecast in one form or another. In the second survey (in October) this number was reduced to 24%. Although this may be partly due to the timing of the second survey,⁴⁷ which was carried out one year after the first forecasts were disseminated, it may also represent regional differences in forecast dissemination. The pre-season forecasts were

⁴⁷ The second survey also included questions regarding the dissemination of the 1998/99 forecasts.

received by twice as many in Caprivi compared to Okavango. Of those who heard the forecasts, most heard it through radio (86%), while some heard it from neighbors (29%) and to a lesser extent, through village meetings, newspapers or meteorological bulletins. The studies revealed that very few respondents received the updated, mid-season forecasts (only 18 out of 202). For those that did hear the mid-season forecasts, radio was the primary source of information.

Table 7. Source of information (% of those farmers who received pre-season forecasts).

Source of information	Ohangwena	Caprivi	Okavango
Meteorological bulletin	0	0	11
Newspaper	0	6	0
Radio	76	94	89
Television	6	6	0
Agricultural extension agency	0	6	0
Neighbors	10	11	67
Aid organizations	0	0	0
Religious organizations	0	0	0
Internet	0	0	0
Village meeting	0	11	0

The forecast was received on a variety of dates. In the Ohangwena region, all but two of the respondents heard a forecast in either September (34%), October (40%), or November (14%).⁴⁸ In Caprivi and Okavango, the forecasts generally reached the farmers earlier (22% received forecasts of some sort during August and September). The farmers in Ohangwena were asked whether the forecasts had been provided early enough, and the majority of respondents (78%) found the time of dissemination to be satisfactory. Most of those who said they received it too late heard the forecast in November (7 of 11).⁴⁹

4.7 Responses and Reactions to Seasonal Forecasts

Among factors affecting agricultural production, weather is considered to be of vital importance to most farmers. Nevertheless, the flexibility to adapt in anticipation of adverse weather is low among communal farmers in Namibia. While climate forecasts can potentially offer valuable information to farmers, their ability to take action based on the forecasts is limited by a number of factors – particularly economic constraints. One objective of the surveys was to identify the extent to which farmers took actions based on the forecasts.

Among the 117 farmers (out of 202) who received pre-season forecasts, the majority (more than 60%) claimed that they had taken actions in response to pre-seasonal forecasts. The most common action was to change planting dates (40%). Changes in the area planted were also frequently reported (35%), as were substitutions of crop types.

⁴⁸ Four respondents answered only “1997”

⁴⁹ The remainder said September (1), December (1) and “1997” (2)

Some of the farmers said that they took actions to prepare for an emergency, such as by increasing food storage to prevent food deficits.

Newspaper reports verify delayed planting activities in all communal crop-producing regions.⁵⁰ To a large extent, farmers were forced to delay planting because soils cannot be prepared until the rains begin. An exception is loose, sandy soils that can be plowed in advance of the rains. Another reason for the delay in planting can be attributed to a lack of draft power to prepare the fields.

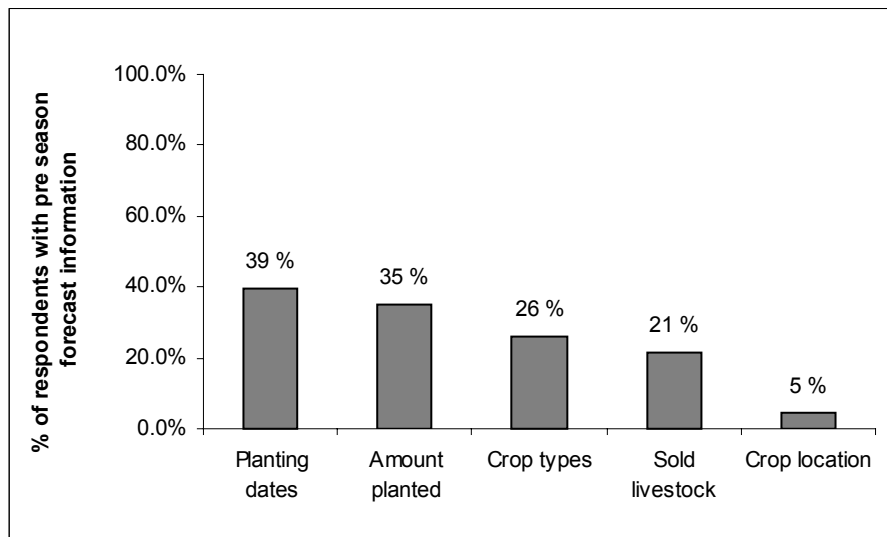


Figure 8. Changes in farm activity due to seasonal climate forecasts.

Reasons for *not* taking action in response to forecasts were first and foremost related to the timing of the forecasts. Many felt that by the time that they had received the forecasts, it was too late to respond. This contradicts the general satisfaction expressed in response to the question “Did you receive the forecasts early enough.” The link between receiving seasonal forecasts and using them for planning may not be well established, as 1997/98 represented the first year that seasonal forecasts were developed in southern Africa.

There was, however, another set of reasons explaining why no actions were taken in response to the forecasts. These can be classified as structural or economic constraints. Among the most frequently mentioned constraints were the lack of resources, lack of technical assistance and lack of input. Despite very limited production directed to the market, the subsistence sector is still dependent on the availability of credit to purchase alternative seeds, pay for transportation and draft power, hire a seasonal workforce, and expand land area under cultivation. Even if credit is available, there may be lack of markets, or inconsistent markets and prices for the product offered. Eighty-four percent of the respondents in Caprivi and Okavango felt that external factors had a strong influence on production.

⁵⁰ Hugh Ellis, 6 January 1998, “Communal Farmers Delay Planting,” *The Namibian*, pp. 5; 3 January 1998, “Wet Xmas Revives Triangle’s Farmers,” *Windhoek Observer*, pp. 10.

Constraints such as a lack of draft power had a clear impact on crop production in the 1997/98 season. Planting began or intensified when the rains arrived in mid-December. Due to the drought, there were not enough donkeys and oxen, which are normally used as draft power to plow the fields. Limited access to tractors made it difficult for many small-scale farmers to take advantage of the good rains. There were not enough government tractors available, and demand was high for the limited number of private tractors. One private tractor owner said that people had started coming to him already in June/July to be first on the list for plowing.⁵¹ The Ministry of Agriculture could not promise further assistance, and doubted whether communal farmers could afford to pay for plowing service provided by the commercial farmers.⁵²

Farmers were also asked if there were actions that they would have preferred to take in response to the forecasts, but which they were unable to carry out, for some reason. A list of the potential actions and the reasons for no action is provided in Table 8.

Table 8. Preferred actions and reasons for inaction.

<i>Potential Action:</i>	<i>Reason for no action:</i>
• Change routine	Low benefit of doing so
• Save money for maize meal / emergencies	Forecast came too late
• Start working the field / plough earlier	Forecast came too late Did not get assistance from government tractor
• Plant early-mature seeds	Too expensive, especially as sales are privatized and subsidies are removed
• Plant traditional seeds	Friends and family insisted that I use government recommended seeds
• Plant government recommended seeds	Could not afford the seeds The seeds were out of stock
• Use artificial fertilizers	Could not get fertilizers Heard that this type of fertilizer spoils one's field
• Plant different types of seeds	Forecast came too late
• Food aid from relatives	Forecast came too late
• Extend the cropping area	Did not get assistance from government tractor

Commercial farmers were not surveyed in this study. However, newspaper reports and informal interviews conducted at an agricultural meeting provide some comparative information as to how commercial farmers in Namibia responded to climate forecasts. There were reports that farmers in the so-called Maize Triangle planted in response to the first rainfall, but that many farmers were being cautious, in anticipation of dry conditions: “[Farmers] are heeding the warnings (...) to diversify and to plant most of their fields with quick growing crops such as fodder, from cow candy to blue buffalo grass.”⁵³ On January 6, 1998, the Namibian reported that farmers in the Northern Maize triangle were

⁵¹ Oswald Shivute, 6 January 1998, “Tractor Shortage Defeats Good Rains in Far North,” *The Namibian*, pp. 3.

⁵² Absalom Shigwedha, 8 January 1998, “Not Enough Money to Provide Ploughs,” *The Namibian*, pp. 3.

⁵³ 3 January 1998, “Wet Xmas Revive Triangle’s Farmers,” *Windhoek Observer*, pp. 10.

“determined to cultivate as much as they can, despite the El Niño threat,” and that the Namibian Agronomy Board estimated that about 80% of the farmers in the Maize Triangle had planted their crops.⁵⁴ Some did not plant at all, but these were considered to be farmers with off-farm incomes.

Commercial farmers reportedly reduced their planted area of maize from 18,000 ha to 12,900 ha.⁵⁵ However, the exact reason for the reduction in area planted was not known. Several factors besides weather may have played a role. Commercial farmers were carrying large loans from four consecutive years of drought, and the good 1996/97 season did not make up for the losses in earlier years in terms of capital or restocking of cattle. The good harvest of 1996/97 did lower prices, which together with the forecasts may have contributed to less planting in the 1997/98 season.

4.8 Outcome for Agricultural Production and Food Security

The first reports on national food supply were that the situation was satisfactory, if planned imports were taken into account.⁵⁶ However, due to a drop in expected yields of two large wheat projects (Hardap and Musese), the forecasted production of wheat was reduced from 6,300 to 4,900 tons.⁵⁷ On March 13, the Emergency Management Unit (EMU) stated that 231,000 Namibians would need drought relief, largely caused by the El Niño weather phenomenon.⁵⁸ The EMU warned that the situation could get worse, and an inter-ministerial committee was set up to deal with the crisis. Although drought conditions were responsible for most of the damage, the hardest hit areas were Caprivi and the northern regions, where the March floods led to a loss of cattle and crops, which compounded the situation.

On March 17, *The Namibian* reported that the drought, which was blamed on El Niño, had destroyed about 70% of the crops in the country, with more damage expected.⁵⁹ Unless good rains fell within two weeks, it was expected that farmers would lose all their harvest. The best yield was expected to be 10% of the 15,000 ha planted. One week later, President Sam Nujoma declared that Namibia must brace itself for another devastating drought.⁶⁰ The Government and EMU were keeping a close watch to ensure that appropriate and timely action was taken to ensure food security and the viability of the agricultural sector.

Some optimism returned when April's good rains in the north “revived dying crops.” There was some hope that the mahangu (millet) farmers who had planted drought-resistant, fast growing seeds (Okashana No 1 variety) could get reasonable crops.⁶¹ Nevertheless, by mid-May a “crop catastrophe” was announced, whereby 25,000 people

⁵⁴ Hugh Ellis, 6 January 1998, “Communal Farmers Delay Planting,” *The Namibian*, pp. 5.

⁵⁵ Sheuyange Asser, Namibia Early Warning System, Ministry of Agriculture, Water and Rural Development. 2 April 1997. Conversation with Lars Otto Naess, Windhoek, Namibia.

⁵⁶ 3 January 1998, “Wet Xmas Revive Triangle's Farmers,” *Windhoek Observer*, pp. 10.

⁵⁷ Helge Schutz, 2 February 1998, “Huge Decline in Agricultural Output,” *The Namibian*.

⁵⁸ Christpin Inambao, 13 March 1998, “231 000 Namibians ‘in need’,” *The Namibian*, pp. 1-2.

⁵⁹ Oswald Shivute, 17 March 1998, “Drought Crisis Looms: Crops Wither, Farmers Abandon Cattle Posts,” *The Namibian*, p. 1.

⁶⁰ Christof Maletsky, 23 March 1998, “Drought Hits Progress: Nujoma Warns of New Emergency,” *The Namibian*, pp. 1-2.

⁶¹ Oswald Shivute, 14 April 1998, “Good Rain in North Revives Dying Crops,” *The Namibian*.

in the Okavango and Caprivi regions faced starvation due to crop failure.⁶² Okavango was the hardest hit region, with more than 2,700 households that did not plant due to poor rains. The country's total coarse grain production was projected at 53,200 tons, compared to the record 166,400 tons of the previous year. Of the total hectares planted in Namibia, 40% was written off because of drought.

By early June, there were strong indications of crop failure and the need to implement drought relief programs. Harvests in the Maize Triangle were only about one-third of the previous year's harvest of 38,600 tons. The national cereal harvest was forecasted at approximately 57,000 tons, equivalent to only one-third of the previous year's bumper harvest, and only half of the average over the previous three years.

It was reported that people had little grain stored, and instead gathered wild fruits to supply their needs. By late June, the EMU estimated that 160,319 Namibians needed drought relief.⁶⁵ The drought relief program included food distribution and food for work to all vulnerable groups, water supply, marketing incentive scheme, compensation for crop loss to both commercial and communal farmers as well as seed voucher scheme. It also included facilitation of loans from the Agricultural Bank, a restocking scheme for communal livestock farmers and support for emergency grazing and transport of animals to and from designated grazing areas.

4.9 Value of the Forecasts

Seasonal forecasts seemed to have done little to prevent crop loss among communal farmers in Namibia. However, this is not surprising, since 1997/98 represented the first year that consensus forecasts were distributed in southern Africa. Small-scale farmers were not targeted directly as end users, therefore no strategies were pursued to ensure that the forecasts reached them. There is more evidence that the forecasts were used by commercial farmers and by agricultural institutions. The SARCOF information as currently presented targets mainly the commercial sector, as they can make ready use of the information and are more familiar with the terminology associated with probability-based forecasts.

Farmers in the first survey were asked how they valued the forecasts. In the second survey, farmers were asked to rank the forecasts on a scale of 1 to 5 in terms of how useful they were, with 1 representing not useful and 5 representing very useful. The results from Ohangwena show that almost half (45%) of the farmers placed a high value on the forecasts. The value was attributed to the reliability of the forecasts, and to the fact that the predictions were actually realized. Comments included: "It is raining, as forecasted;" "We did receive low rainfall as predicted;" or less commonly, "The forecast was presented by an expert."

Although 45% of the farmers placed great value in the forecasts, some felt that they were of little (8%) or no value (6%). Reliability was again a factor, in this case because the predictions were considered wrong: "It rained better, not less like they said." Other farmers were skeptical to the ability of experts to forecast weather conditions: "Rainfall is a gift from God, whether we predict to have it or not, this will depend on God himself;"

⁶² Tabby Moyo, 15 May 1998, "Crop Catastrophe," *The Namibian*.

⁶⁵ Tabby Moyo, 25 June 1998, "160 319 Namibians Need Drought Relief," *The Namibian*.

or “Rainfall is not from people, but a gift from God. Whether we predict to be no rainfall that year, God can dramatically change it and give it to us.”

An overwhelming majority (88%) of communal farmers in Caprivi and Okavango considered seasonal forecasts to be very useful (see Table 9). Forecasts were highly valued as a tool for decision-making. This is despite the fact that only 10% of the respondents in Caprivi and Okavango actually received a forecast. It was clear from the responses that most farmers knew little about the seasonal forecasts, yet many farmers were very interested in obtaining them.

Table 9. Evaluation of forecast usefulness.

<i>Region</i>	<i>Level of usefulness</i>				
	1 (low)	2	3	4	5 (high)
Caprivi and Kavango	3%	3%	5%	2%	88%

4.10 Conclusions

The 1997/98 season marked the first year that a consensus seasonal climate forecast was distributed in Namibia. Coinciding with one of the strongest El Niño events on record, there was ample potential for farmers to benefit from the information. However, the forecasts did not reach most small-scale farmers. Very few of those that did receive the information used the forecasts as a basis for changing production strategies. Farmers were constrained by either low confidence in the information, or by structural constraints such as a lack of draft power or alternative seeds. Nevertheless, farmers place a high value on such forecasts, and consider the information desirable.

The 1997/98 season can be considered a learning experience regarding the use of seasonal climate forecasts in Namibia. A number of critical remarks were collected relating to how the forecasts were issued and distributed, how accurate they were in case of Namibia, and how useful they were for the farmers:

- The forecasts were not specific enough. They do not indicate how much “below normal” refers to, and most people were not familiar with the 30-year data upon which the probabilities were based.
- The forecasts were difficult for laymen to understand. Some farmers suggested forecast education for farmers and the establishment of a weather information center where farmers can collect forecasts.
- Despite good institutional set-up, there was a lack of implementation of measures to counteract the predicted drought. After the initial forecast for a dry season, the government did little to implement preparatory measures, focusing instead on emergency measures.

5 Case Study II: Farmer Responses to Forecasts in Tanzania

Like Namibia, Tanzania is heavily dependent upon small-scale agriculture to feed its population. Unlike Namibia, however, Tanzania has a subhumid climate with ample but variable rainfall. In the 1997/98 period, above-normal rainfall was predicted for the northern half of Tanzania. The country did receive greater than average rainfall, which resulted in heavy flooding. In contrast to the drought situation in Namibia, the heavy rains had some benefits for crop production in Tanzania, but proved to be damaging to infrastructure, and impeded the marketing of crops. The case studies carried out in Tanzania aimed at identifying whether farmers received seasonal climate forecasts for the 1997/98 growing season, and if so, whether they took actions.

5.1 Tanzania



Figure 9. Map of Tanzania.

The United Republic of Tanzania is located on the southeastern coast of Africa and is comprised of the mainland and two islands (Zanzibar and Pemba). Although it is part of SADC, it is situated in East Africa, bordering Mozambique to the south, Kenya and Uganda to the north, and Rwanda, Burundi, Democratic Republic of the Congo, Zambia and Malawi to the east. Tanzania has a population of 29.5 million (1997), with an estimated population growth rate of 2.8% (1998). Of the total population, 22% is located in urban areas. The capital is Dodoma, and the largest city is Dar es Salaam. Tanzania has an area of 945,090 km², and an average population density of 31 per square kilometer. However, almost two-thirds of the people live in areas that together amount to only about 10% of the total area. The northern and southern highlands of the country are the most populated, with more than 150 persons per square kilometer.

Tanzania is one of the poorest countries in the world. The country's GDP per capita is estimated at USD 650 (1995). The economy is heavily dependent on agriculture, which accounts for 58% of GDP, provides 85% of exports, and employs 90% of the work force.

Industry accounts for 8% of GDP and is mainly limited to processing agricultural products and light consumer goods. The economic recovery program announced in mid-1986 has generated notable increases in agricultural production. However, growth from 1991 has been tied largely to increases in industrial production and a substantial increase in output of minerals, led by gold. Recent banking reforms have helped increase private sector growth and investment.

The rural Tanzanian population lives in about 8500 villages, and is very poor. Most villages lack good roads. Poor infrastructure makes it difficult to buy and transport materials such as fertilizers and improved seed varieties. It also limits access to the market, and access to information (eg. weather forecasts, family planning information). Half of the Tanzanian population lacks access to safe water and nearly half of the children do not attend primary school. Economic reforms introducing cost sharing in health and education sectors have reduced access to these services for the poor, who cannot afford to purchase them.

The topography and climatic conditions of Tanzania restrict the amount of arable land for cropping to 3% of the total area. Agricultural potential is limited over large areas of the country by a combination of low soil fertility and low and erratic rainfall. Truly fertile soils are confined to: (i) the volcanic soils of the Northern highlands; (ii) soils of Southern highlands; and (iii) the alluvial soils in large river basins. It is estimated that only 5% (7 million ha) of the total land area is currently under cultivation, of which 14% is occupied by permanent crops. Only 22% of the land receives 570 mm or more of rainfall in 9 years out of 10. Furthermore, in many parts of the country potential evapotranspiration exceeds rainfall for over nine months of the year.

Agricultural production in Tanzania is predominantly subsistence based, and is undertaken by some 2.5 million farming families, each cultivating an average of 2 ha of cropland. Major domestic food crops are maize, roots, tubers, sorghum, pulses, plantains, and rice. Most of the food grown by farmers is produced using hand implements. Very little new technology is used, and limited extension and research intervention is available. Most of the improved technology is used on large commercial farms. Crop production is the major branch of agriculture, accounting for 55% of agricultural GDP. This is followed by livestock at 30%, and forestry and fisheries at 15%.⁶⁴ The growing season in Tanzania lasts from December until June, with the marketing year extending from June to May.

Tanzania as a country is nearly food sufficient, with net cereal imports of only 150,000 metric tons. However, the country experiences internal food distribution problems. Consequently, the household-level food supply is still largely dependent on direct food production, which is also influenced by poor marketing infrastructure in the country. For this reason, a large section of the population is faced with food insecurity.

Almost all irrigation water on the mainland is surface water coming from rivers, streams and springs. In only a few cases have storage reservoirs been constructed. Sprinkler irrigation is used on some large-scale projects, but it is rather expensive. In the semi-arid central lowlands, with annual rainfall below 500 mm, various forms of water harvesting, micro-catchment and other techniques are used to try to control and concentrate rainfall

⁶⁴ G.M. Mitawa and W.Y.F. Marundu, 1995, "Tanzania: Country Report to the FAO International Technical Conference on Plant Genetic Resources (Leipzig 1996), [Internet, WWW], ADDRESS: <http://web.icppgr.fao.org/pdf/tanzania.pdf>.

runoff. The potential for irrigation development is estimated to be 828,000 ha, or 2% of the cultivable area. It is estimated that somewhere between 120,000 and 200,000 ha (between 14 and 24% of the potential) is currently under irrigation. Most of this is in traditional, smallholder schemes. In small-scale projects, most of the irrigated area is occupied by rice. In some limited areas, maize is cultivated, and there are some trials with vegetables and horticulture under irrigation.

5.2 Climate

Tanzania has a climate that varies from tropical along the coast to temperate in the highlands. Although average precipitation is 937 mm per year, 50% of the country receives less than 750 mm. Total rainfall decreases along a north-south gradient. Rainfall is highly seasonal, and most of the country experiences a long dry season between May and October. Rainfall in the northeast of Tanzania is characterized as bimodal, with peaks in both October/November and April/May. The short rains are known as *vuli*, and the long rains are referred to as *masika*. On the coast, rainy seasons occur from March to May and from November to December. Around Lake Victoria, rainfall is distributed throughout the year, peaking between March and May. In the south, dry seasons occur from May/June to September/October. Mean annual temperatures in Tanzania are closely related to elevation, and are also influenced by proximity to the coast.

5.3 SARCOF Forecasts

The SARCOF forecast for Tanzania placed a high probability on above-normal rainfall for the short rains in northern Tanzania during the first period (OND). In the central and southern parts of the country, normal to above-normal rainfall was predicted. For the second period (DJFM), only the central and southern parts of the country were covered by the forecasts. These forecasts were for normal to above-normal rainfall. For the extreme southern parts of Tanzania, the likelihood of above-normal rainfall was slightly lower than for the rest of the country.

Tanzania was also covered by the climate outlook issued by the Greater Horn of Africa Regional Climate Outlook Forum, which was disseminated in February 1998.⁶⁵ The forecast for the March to May period anticipated normal to above-normal rainfall for both the coastal region of northern Tanzania and the western regions of Tanzania.

The 1997/98 forecasts came in the aftermath of a particularly difficult year for Tanzanian farmers. In the 1996/97 season, short rains in the bimodal rainfall areas in the north were poor, and the onset of seasonal rainfall in the south was delayed. Both annual and perennial crops were affected by the drought. When the long rains started in late March, they brought relief to the worst hit areas but also caused deaths and created widespread damage due to flooding. In late April, crops in the southern areas were reported to be in good conditions due to favorable weather, while crops in the northeastern and northern coastal areas suffered from the late onset of the rains. On September 15, 1997, President Benjamin Mkapa announced a national deficit of 916,000 metric tons of cereals, and appealed for international food aid. Food aid was provided by the World Food Program.

⁶⁵ NOAA Office of Global Programs. 1999, "An Experiment in the Application of Climate Forecasts: NOAA-OGP Activities Related to the 1997-98 El Niño Event," Office of Global Programs, National Oceanic and Atmospheric Administration, U.S. Department of Commerce. January 1999.

Amidst fears of severe food shortages, however, grain procurement for Strategic Grain Reserve stopped in December 1997, reportedly due to budgetary constraints.⁶⁶

Prior to the onset of the 1997/98 rains, there were several reports on the linkages between the El Niño phenomenon and rainfall in Tanzania. A workshop on long-term forecasts held in April 1997 emphasized the impact of El Niño on the weather in Tanzania.⁶⁷ On the July 21, 1997, the Directorate of Meteorology presented a statement predicting normal to wetter than normal conditions for the northern coast and the north eastern highlands, and slightly drier than normal to near normal rainfall over the Lake Victoria basin. Reference was made to the El Niño episode under development: "(...) it is likely that atmospheric circulation anomalies, consistent with those experienced during warm episode (El Niño) years should develop in the near future. It is therefore felt that rainfall patterns that normally prevail during warm episode years are likely to be experienced in Tanzania particularly during the northern sector short rains (October to December) and the southern sector seasonal rains (December to April)."⁶⁸ The southern sector and central areas were predicted to receive normal seasonal rainfall. The statement cautioned that the forecast "should be treated as a general advice with modest predictive skill." The Director General of the Directorate of Meteorology, Dr M. Mhita, also provided background articles on the El Niño phenomenon and its impacts in Tanzania.

In Tanzania, meteorological forecasts are often accompanied by advice to farmers, such that they can maximize benefits and minimize damages from the forecasted weather. For example, the Daily News reported on September 4 that the Lake Victoria basin and surrounding areas were likely to experience average to below-average rainfall, and that farmers should take advantage of the short rains by planting drought resistant and early maturing crops.⁶⁹

A statement issued by the Directorate of Meteorology on December 4 reported up to 600% of normal rainfall in some areas (Pemba, Tanga and Zanzibar). The weather was attributed to the influence of El Niño, and it was forecasted that the conditions would prevail until April 1998.⁷⁰ By the end of January, the Directorate of Meteorology predicted that the rains would continue until May, with possibilities of increased outbreaks of diseases, problems in food transportation, and lower crop yields.⁷¹

While the earliest forecasts indicated normal to above and normal to below rainfall, the heavy rains in October-December seem to have taken many by surprise. Given the situation in the 1996/97 season, the arrival of rains in the coastal areas and Zanzibar in early October was first met with considerable optimism for the coming season. Again farmers were encouraged to "take advantage of these rains and start planting drought

⁶⁶ Jaston Binala, 25 June 1998, "Country to Have Good Harvest After All," *The Express*.

⁶⁷ National Workshop on Long Range Weather Forecasting, 30 April 1997, Dar es Salaam.

⁶⁸ Buruhani S. Nyenzi, Ag. Director General, Directorate of Meteorology, Tanzania, 21 July 1997, "Statement of Current Weather Situation in the Country as of 20th July and Outlook for the Short Rains Season 1997, DM/1622.

⁶⁹ 4 September 1997, "Short Rains Expected," *Daily News*.

⁷⁰ 5 December 1998, "Short Rains Above Average – MET," *Daily News*.

⁷¹ Tuma Abdallah, 29 January 1998, "Weather Onslaught on Transport System Looms," *Daily News*.

resistant and fast maturing food crops varieties.”⁷² From October, however, reports of floods and other damages became increasingly frequent (see Table 10).

Table 10. A selection of reported rain-related damages during the 1997/98 season, Tanzania.

<i>Date</i>	<i>Damages Reported</i>	<i>Source</i>
13.10.97	Houses destroyed by rains in Chunya. 6 people injured, 70 rendered homeless	Daily News
22.10.97	Two people drowned, two others injured, 30 families left homeless in Zanzibar	Daily News
01.12.97	83 houses damages by floods, 400 left homeless, 580 acres of crops washed away, 120 herds of cattle and goat lost. Bunda District, Mara Region	Africa Network, Panafrican News Agency
04.12.97	Road transport between Arusha, Dodoma and Singida paralyzed	Daily News
18.12.97	632 km of roads in Tanzania damaged by heavy rains	Daily News
19.12.97	1259 acres of paddy and maize destroyed in Rufiji	Daily News
23.12.97	789 families left homeless after heavy floods. Transportation of food commodities stopped after rains washed away bridge. Bukoba District	Daily News
24.12.97	Railway network impaired, Dodoma and Morogoro Region	Daily News
25.12.97	600 houses washed away, 700 families homeless, Kiteto District	Daily News
25.12.97	768 houses destroyed, 7,141 people homeless, Urambo District, Tabora Region	Daily News
28.12.97	20 killed by floods, 13,000 people displaced, price hikes of essential commodities due to transport problems following destruction of bridge. Tabora Region	Daily News
01.01.98	128 houses, 400 hectares of farm destroyed, roads impaired, Manyoni District	Daily News
02.01.98	11 people killed, 241 houses collapsed, transport cut off, fears of serious food shortages	Daily News
02.01.98	Bad weather lowers revenue collection. Disruption of transport network results in price hikes of commodities	Daily News
02.03.98	300 houses destroyed, 9,000 acres of paddy and 925 acres of millet washed away.	Daily News
05.03.98	300 houses destroyed, 2,000 acres of mixed crops covered with water	Daily News
18.04.98	Mine disaster, about 100 killed, Arusha	The Guardian

⁷² Semu Mwakyanjala, 1 October 1997, “Met Forecasts Wet Season,” *Daily News*.

5.4 The Study Region and Respondent Profiles

The two surveys were undertaken in Morogoro and Iringa, which are neighboring regions in the central to eastern part of the country. The Morogoro Region is divided into four districts: Morogoro (town and rural area), Kilosa, Kilombero and Ulanga. The Iringa Region consists of five districts: Iringa, Njombe, Ludewa, Makete and Mufindi. Based on the 1988 census and at the regions' population growth rates, the total population in 1998 is estimated at 1.58 million for each of the two regions (Table 11). Morogoro lies in the transition zone between unimodal and bimodal rainfall belts. Iringa has a unimodal rainfall pattern, i.e. only one rainy season. Two districts from each region were selected for both a pilot study and a follow-up study. These are Morogoro and Kilosa from Morogoro Region and Iringa and Mufindi from Iringa Region.

Both regions are accessible by railroad and by a good paved road extending from Dar es Salaam to Zambia. Morogoro town is the closest large urban area to Dar es Salaam, followed by Iringa. People staying in these regions are employed in various sectors of the economy, such as agriculture, manufacturing, construction, electricity and water, trade and commerce, government and community services.

Table 11. Population statistics for Morogoro and Iringa Regions.

<i>Region</i>	<i>Population 1988</i>	<i>Population 1998 (est.)</i>	<i>Growth rate (1978- 1988)</i>	<i>% Female</i>	<i>% Male</i>	<i>Average household size</i>
Morogoro	1 222 737	1 580 531	2.6%	50.5	49.5	5.3
Iringa	1 208 914	1 577 914	2.7%	53.2	46.8	4.8

Source: Adapted and calculated from Bureau of Statistics, 1988.

The total number of respondents was 198 in the pilot survey (April 1998) and 299 in the second survey (October 1998). The first survey included 99 respondents from Morogoro, and 99 from Iringa. In the second survey, 150 respondents were from Morogoro and 149 were from Iringa. Different households were covered in the two surveys, and the questionnaires were slightly different. The results from the second survey are emphasized here, with the first survey serving as complementary information. Two-thirds of the respondents in each survey were men, and the average age of those surveyed was 44 years.

The average farm size was 2.1 ha, with each farm supporting an average of 6.4 persons. Most farms depend upon family labor supply during the year. Although some farms employ labor in the peak season through short-term contracts, the use of a permanent labor force is uncommon in Morogoro and Iringa.

The major crops grown in Morogoro and Iringa are maize, beans, cassava, cowpeas, and rice. On average, households plant 1.3 ha with maize, and market only about 10% of this. For traditional cash crops such as coffee, cotton, and bananas, as well as for diverse vegetables, the share marketed is much higher.

Farmers in Morogoro and Iringa receive most of their annual income (50-80%) from agricultural production. Animal husbandry is also common, with more than 40% of the

farmers receiving income from livestock. The share of farmers engaging in commercial business and wage labor is also quite high. The average contributions of different sources of income are shown in Figure 10.

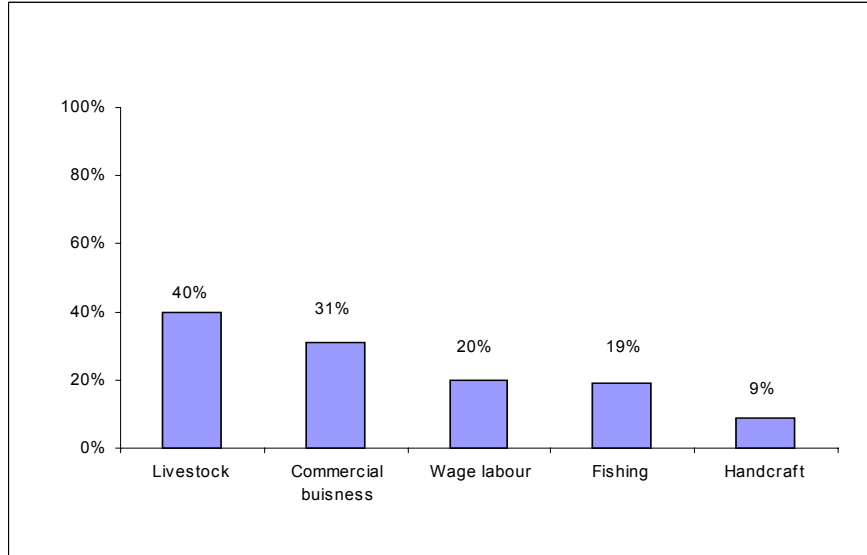


Figure 10. Other sources of income (% of respondents).

5.5 Perceptions of Climate Variability

Farmers were asked to describe the weather in the 1997/98 season. In both regions, almost all respondents felt that the weather this season had been “not normal.” This was attributed to either too much rain or very heavy rains that were destructive. Only a handful said the rains were normal or just enough.

Most farmers (83%) said that the weather had negatively affected their production during the 1997/98 season. Some farmers failed to cultivate any crops due to the flooding of fields. The effects caused by heavy rains included: destruction of crops in the fields; increased vermin, pests, and crop diseases; washing away of fertilizer; and erosion. A few farmers (10%), all from Kilosa District, said the weather affected their production positively, as rice fields were field with water. However, most of the farmers said that the effects were negative on other crops. Only 2% said there was no effect in production due to weather, and 5% had no comments. Only a few farmers (8%) received aid as a result of weather affecting their crops. The aid came from the Government and religious organizations. The aid was in the form of seeds or food.

As in many other regions in Tanzania, farmers in the Morogoro and Iringa regions sometimes use environmental phenomena as weather indicators. The majority of respondents in the survey (87%) did not see any early signals of the year’s anomalous weather. Those who did (13%) cited signals such as a lunar eclipse, sighting of “kakakuona” in a stream, sighting of a tortoise, outbreaks of insects and/or frogs, appearance of a certain star, the observation that “many birds were flying”, or the occurrence of brown ants. The signals recognized most commonly are listed in Table 12.

Table 12. Early signs advanced for an abnormal season (% of respondents).

Signs	Percentage
Outbreak of butterflies	27
Very sunny and hotter	27
Floods at the beginning of rains	27
Started raining too early	27
Dryness of previous season	36
Outbreak of brown ants	73
Animals called "maboka" moving from one mountain to another	9
Outbreak of frogs	9
A very cool condition	9
Rainy season started late	9
Occurrence of a rare species of animal called "kakakuona"	9
Occurrence of a rare species of birds called "lawalawa"	9
Have general knowledge of 10-year cycle of heavy rains	9
A circle around the sun at 8:00 a.m. everyday	9
Location of moon in early October 1997 signified the emergence of bad weather	9

5.6 Dissemination of Seasonal Forecasts

One of the objectives of the surveys was to find out whether and how the seasonal forecasts reached farmers in Tanzania. There were large differences between the two surveys regarding how many received the forecasts. In the pilot study, almost half of the respondents (49%) said they had received a pre-season forecast. There was, however, a sharp contrast between the number of farmers in Morogoro that received the forecasts and the corresponding number of farmers in Iringa (Table 16). In the second survey, only 7% of the respondents said they had received such forecast information, with the majority of these located in Morogoro.

Table 13. Share of farmers receiving the pre-seasonal forecast.

Region	Farmers receiving the pre-seasonal forecast % (persons)	
	<i>Pilot survey</i>	<i>Second survey</i>
Morogoro and Iringa	49% (98)	7% (22)
Morogoro	86% (86)	3% (19)
Iringa	12% (12)	2% (3)

There were also large differences in how the farmers received the forecasts. Among the farmers in the pilot survey, it was more common to receive the weather information through local sources, which largely refers to neighbors and village meetings. In the second survey, the radio turned out to be the main information source, even though the local channels for dissemination turned out to have a strong influence. Very few received seasonal forecasts from agricultural extension workers. As many as 62.2% received updated mid-season forecasts (compared to only 15% in Namibia) in the second survey. In the pilot study, fewer (48%) farmers received updated forecasts. There was, however, little overlap with those who received pre-season forecasts.

It seems that the farmers had a great deal of confidence in the messages that were received. Reasons for such confidence were attributed to the credibility of radio, and to the fact that the weather conditions were as predicted by the forecasts.

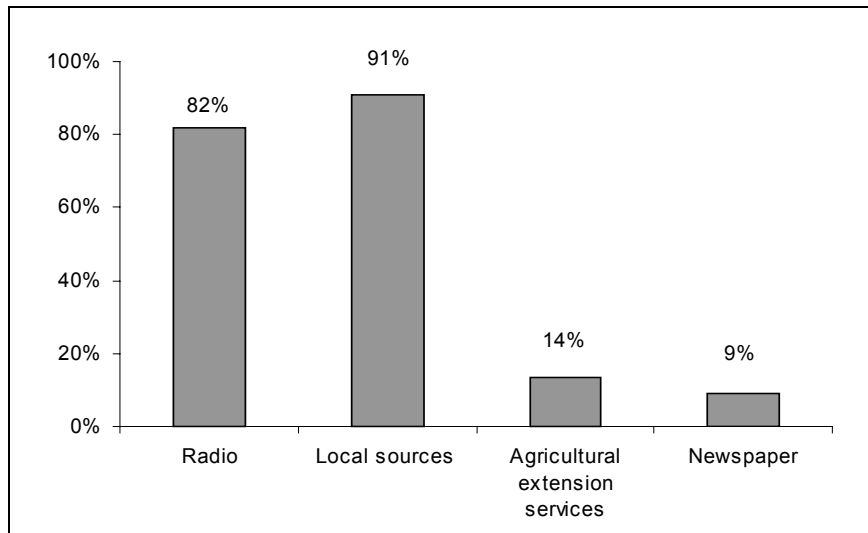


Figure 11. Source information (0% of farmers receiving the pre-season forecasts).

In the pilot survey, the majority (86%) of farmers said that they received the forecasts between September 1997 and March 1998. The general opinion among the farmers was that the forecasts were received too late. However, forecasts that were too late for planning for the short rains could still be early enough to plan for the long rains, but the questionnaire did not follow up on this. All those who received forecasts in March remarked that it came too late. Almost half of the respondents (54.5%) in the second survey who had heard the forecasts received them by October 1997. Over one quarter of the respondents could not remember when they received the forecasts.

Among agricultural institutions, there were differing views on whether the forecasts came out early enough and whether they actually reached the farmers. Some argued that they came on time and that farmers had enough time to plant, but the problem was that farmers did not believe the forecasts, or that they didn't have many options for acting in response to the forecasts. Others were unsure as to whether farmers received the forecasts, but had the impression that they did not get the information. The lack of follow-up and monitoring of responses to the forecasts was mentioned as a problem, particularly in the case of more remote areas, where distribution was cut off by damages to roads and railways. Even if forecasts did reach farmers, there were doubts as to whether farmers had many options for responding.

5.7 Responses and Reactions to Seasonal Forecasts

Farmers were asked whether they had used the forecasts to prepare for potential emergencies. Of those who actually heard the forecasts, 73% used them to prepare for

potential emergencies. This most often involved storing food to avoid shortages. Some farmers also repaired their houses to prepare for floods. Some of those who answered that they did not prepare for emergencies commented that they did not believe it would rain as much as forecasted, or that they had no alternatives.

In the pilot survey, farmers seemed to be rather unwilling to make any changes in response to available weather forecasts. In fact, as many as 92% answered that “no changes were made” in response to pre-season forecasts. In the second survey only 13% of the limited number of farmers who received the forecasts answered that “no changes were made” in response to pre-season forecasts. Of the changes that were made, changes in planting date were the most common action (41%), followed by changes in crop location (14%), crop type (9%), and area farmed (4%).

The actions that were taken in response to the forecasts are listed below, with the most frequent answers appearing first:

- Change planting dates. Most farmers said they wanted to plant *later* in order to avoid the losses due to the harsh conditions during short rains. Some said they would have preferred to plant *earlier*.
- Change crop locations (for example, from lowlands to highlands, or to reserved land because of its high fertility).
- Change crop types (for example, plant vegetables, make a garden, and change from maize to rice because rice grows under wet conditions).
- Inter-crop to avoid/minimize soil erosion.
- Reduce amount planted in order to minimize production costs, escape losses due to floods and save more money for food crops.
- Stop farm activities and enter into commercial business to avoid costs incurred by flooding.
- Store more food to avoid shortages.
- Use fertilizer.

While some farmers could and did take actions in response to the forecasts, there were many who did not take action (particularly in the pilot study). Some of the reasons for not taking action include:

- Not sure about the forecasts (i.e., did not believe the information).
- The forecasts came too late.
- Not enough autonomy in household decision-making (gender issues).
- Lack of money to carry out preferred actions.

- Floods resulted in too much water in the fields. (For example, tomato seedlings were washed away by the rains, and there was too much water for growing Irish potatoes.)
- “Not in a position to alter or change routines” such as changing crop types and planting dates.
- Would not make any changes because every action depends on God’s will.
- Shortage of farmland.

The most frequently mentioned reason for not taking action relates to uncertainty about the forecasts, and reflects skepticism towards seasonal forecast information in general. Many characterized the situation as follows; “the forecasts were too summarized to comprehend”; “there was nothing one can do or prepare for given any situation”; “the forecasts are generally not reliable” or “issued too late.” The other reasons given are not directly related to forecasts. There appears to be a gender-bias in the ability to take actions, as many female respondents answer that they have little power in changing routines and are “under the will of their husband.” Several farmers mentioned a lack of money and shortage of farmland.

The economic and social environment surrounding the farmers turned out to be of vital importance in determining the farmers’ ability to take actions. According to Table 14, the most influential external factor was the level and fluctuations in crop prices. Crop prices affected different groups of farmers differently, depending on whether they bought or sold crops. A total of 24% answered that higher crop prices had affected their production positively, whereas 10% had been affected negatively by higher crop prices. Other external factors that influenced production were restricted marketing options (20%), lack of money (6%), higher transportation prices (6%) and higher pesticide prices (5%).

Table 14. Other factors affecting farmers’ production.

Factor	Effect(s)	Main (%)
Higher crop prices	Positive effect because more money will be obtained, hence increased crop production next season.	24
Reduced marketing options	Negative effect as more cash will be allocated for food crops. Negative effect because crops are perishables (bananas, cowpeas, cabbages etc.).	20
Higher crop prices	Negative effect as more cash will be allocated for food crops and little money will be obtained for cultivating next year	10
Lack of funds	Little money to buy fertilizer, pesticides, and good seeds	6
Higher transportation prices	Negative effect	6
Higher pesticide prices	Negative effect	5
Other	Food shortage, high seed prices, high fertilizer prices	7

5.8 Outcome for Agricultural Production and Food Security

The SADC food security bulletin of February 13 stated that due to the heavy rains and floods, the crop area planted “is hardly expected to exceed 75% of that cultivated last season.”⁷³ At the same time, the report states that the state of the maize crop is generally good. The cereal deficit was assessed at 916,000 metric tons – the same figure given by the President in September. The maize stocks at that time were assessed at 216,000 metric tons, including a Strategic Grain Reserve of 52,511 metric tons. The report stated that the government would have to appeal for additional food aid because private traders failed to import large amounts of maize.

A similar, but somewhat more optimistic picture was given by the FAO/WFP crop assessment report of February 19.⁷⁴ It noted that central areas like Dar es Salaam, Morogoro and Arusha had a reasonably stable food supply situation. The report added that international (CIF) prices had remained remarkably low. This may be one reason why the private sector was reluctant to import larger quantities of grain, in spite of the official waiver on maize duties. However, there were serious concerns for the food supply situation in areas that had experienced poor harvests in the previous year, and where transportation had been damaged. Rising food prices placed groups with limited purchasing power at high risk, and the main priority was identified as moving food between surplus and deficit regions, instead of importing food from abroad.

The report also states that in spite of widespread devastation, the rains could actually increase production in higher areas and predominantly sandy loam soils, which may offset some of the losses in low lying areas. The import requirement was estimated at 250,000 metric tons for the remaining four months of the 1997/98 marketing year. 91,000 metric tons of these were in the pipeline for commercial and food aid import, and it was noted that if domestic prices increased relative to international prices, the private sector could be expected to purchase the balance.

News reports in June and July 1998 indicated that harvests were better than first estimated.⁷⁵ Nevertheless, most farmers surveyed for this study recorded below average yields in the season 1997/98, as indicated in Table 15. Maize, the staple food of the majority and cultivated by 99% of the respondents performed below average on 55.4% of the farms during the short rains (vuli) season (33.7% did not respond to the question). During the long rain season (masika), 73% of the farmers recorded below average yields. Two percent recorded average yield, 0.3% above average yields while 24.7% did not respond to the question. Bean yields (another staple food), were similarly affected. However, some crops were not affected by the weather. These include cassava, cowpeas, banana, sweet potatoes, sugarcane, yams, coconuts and sisal.

⁷³ SADC Food Security Bulletin, [Internet, WWW], ADDRESS: <http://www.zimbabwe.net/sadcfanr/na/natoc1e.htm>.

⁷⁴ FAO/WFP, 1998, “Crop and Food Supply Assessment Mission to the United Republic of Tanzania.” 19 February 1998, [Internet, WWW], <http://wwwwww.reliefweb.int/w/rwb.nsf/s/E6EF5C9033B87369C12565B100386FBC>

⁷⁵ Jaston Binala, June 25 – July 1, 1998 “Country to have good harvest after all” *The Express*.

Table 15. Yield of different crops in the 1997/98 season (percentage of farmers growing the crop).

	Yields in the Short-rain Season (Vuli)				Yields in the Long-rain Season (Masika)			
	Below average	Above average	Average	No answer	Below Average	Above Average	Average	No answer
Maize	55.4	1.4	9.5	33.7	73	0.3	2	24.7
Sorghum	30	0	0	70	70	0	10	20
Millet					0	50	0	50
Cassava	6.3		58.9	34.8	14.7	1.1	73.7	10.5
Cowpeas	12.3	1.5	81.5	4.7	20.6	1.5	77.9	0
Cotton	33.3		66.7	0	100	0	0	0
Groundnuts	100	0	0	0	75	0	0	25
Rice	16.9	1.5	3.1	78.5	21.5	13.8	56.9	7.8
Banana	6.5	15.1	57	21.4	9.7	25.8	53.8	10.7
Coffee	21.4	14.3	50	14.3	21.4	35.7	14.3	28.6
Beans	86.1	1.4	9.7	2.8	86.7	0.7	5.3	7.3
Cabbage	2.3	0	0	97.7	72.7	9.1	18.2	0
Sweet potatoes	0	0	5.4	94.6	26.8	0	73.2	0
Irish potatoes					22.6	0	38.7	38.7
Onions					41.7	0	50	8.3
Sugarcane	11.8	0	11.8	76.4	17.6	0	70.6	11.8
Yams	0	0	50	50	25	0	75	0
Carrots					50	0	50	0
Tomatoes					33.3	0	55.6	11.1
Sweet pepper					25	0	75	0
Vegetables	50	0	0	50	40	0	0	60
Timber trees								100
Coconut trees					0	0	100	0
Sunflower					50	0	0	50
Sisal	0	0	100	0	0	0	100	0
Garden peas					50	0	50	0

5.9 Value of the Forecasts

From the survey, seasonal forecasts seem to have had some impact on farmers' planning of the crop season. In the pilot survey, a much larger number (49%) of farmers reported to have heard such forecasts. Although only 7% received pre-season forecasts in the second survey, a much larger percentage (62%) received updated forecasts during the season. The most common sources were neighbors, village meetings, and radio, followed by the extension service. Of those who received the pre-season forecast, 86% (8% in the pilot study) took actions on basis of the information. Over half of the farmers (56%) from the second survey who received a mid-season forecast (62%) changed their plans based on this. At the same time, as many as 57% used the forecast to prepare for potential emergency situations.

The two most frequently cited reasons for not acting were that they did not trust the forecast information, and that the forecasts came too late (86%). More than two-thirds received the forecast in December or later. Considering that the first seasonal forecast from the Directorate of Meteorology was issued in July, and the first SARCOF forecast in September, there appears to be a significant potential for improvement here. As many as 95% (99% in the pilot survey) said the forecast was representative for what actually happened.

The Directorate of Meteorology played a very active role in the news media throughout the 1997/98 season. Farmers were assisted with seeds, mainly drought-resistant and early maturing varieties. Private traders were encouraged to import food, but failed to do so, which could be due to (1) more risks involved, (2) too low prices on the domestic market to be profitable, or (3) lack of experience of traders. Until then they had been used to importing low volumes of high value crops, while the need in 1997/98 was to import high volumes of low value crops.

Conflicting information seems to have come out before the season regarding what kind of weather to expect. Some thought the forecast was for a dry season, others thought it would be heavy rainfall. One respondent said he had heard the season would start earlier than normal. The confusion may be attributed to at least two factors. First, there was the drought of the preceding season. The President declared a national food crisis in mid-September and farmers were given assistance for planting drought-resistant crops and early maturing varieties. While some may have received the message forecasting above normal rainfall, it seems clear that the heavy rains seem to have taken most people by surprise. Moreover, nobody was prepared for the increased pest damage and damage to roads/infrastructure. Second, El Niño itself was a “new” phenomenon to most people, and it took a while before the message came through as to what to expect. Many of those who knew about El Niño associated it with drought, not heavy rainfall. It seems that most became familiar with El Niño well after the heavy rains had started and the effects were evident.

Nevertheless, many of the farmers surveyed in October, 1998 felt that the climate forecasts were very useful. As seen in Table 16, over 51% ranked them as 5 on a scale of 1 to 5, and 75% ranked them as 3 or above. In short, climate forecasts are considered useful to farmers, regardless of their ability to actually use the information.

Table 16. Evaluation of forecast usefulness.

<i>Region</i>	<i>Level of usefulness</i>				
	1 (low)	2	3	4	5 (high)
Iringa and Morogoro	13%	5%	14%	12%	51%

5.10 Conclusions

As in the case of Namibia, the 1997/98 seasonal forecasts did not reach many small-scale farmers in Tanzania. The situation in Tanzania was complicated by the fact that the country was experiencing the aftermath of the previous season’s drought, and by the

strong association between El Niño and drought. The above-normal rains took many by surprise, and had negative impacts on crop production among the farmers interviewed.

Unlike Namibia, the forecasts distributed in Tanzania were accompanied by advice for planting. Crops such as rice benefitted from the heavy rains, but marketing was difficult because roads and bridges had been destroyed by heavy flooding. The forecasts for Tanzania performed well, and there is potential for farmers to use them more proactively, in conjunction with the accompanying advice from government institutions. The constraints to actions in Tanzania include the timing of the forecasts, limited confidence in the forecasts and the restricted ability of women to make autonomous decisions about production. External factors also constrain production possibilities, including crop prices, and availability of funds to purchase production inputs.

The Tanzania case study shows that seasonal forecasts can potentially make a positive contribution to small-scale agricultural production. However, as in Namibia, the 1997/98 season should be considered a learning experience. There is ample room for improving the timing and distribution of the forecasts, and for increasing the ability and flexibility of farmers to alter production strategies in response to the forecasted conditions.

6 Seasonal Forecasts: Is Information Enough?

Long before the first forecast was issued by SARCOF, media attention was heavily focused on predictions of an unusually strong El Niño event. Referring to past El Niño events of similar magnitude (especially that of 1991/92), news reports often contained alarming messages about potential impacts on agricultural yields. Phrases such as “drought,” “crisis,” “economic tremor,” “havoc,” “uncertainty,” and “confusion” appear frequently in news articles from July to December. As it turned out, however, the actual weather conditions did not resemble those of the 1991/92 El Niño season. In some parts of Southern Africa, notably Zimbabwe and South Africa, the effects were not as severe as many anticipated from the media reports. In Tanzania, many were taken by surprise by the heavy rains, which destroyed infrastructure and damaged crops. Newspaper reports from January to April 1998 included phrases such as “El Niño scare,” “over-publicity,” and “much ado about nothing.” In April 1998, one paper noted that “If it were not for the panic following the widespread publicity about the worst El Niño strike in many years, farmers could have had much better harvests.”⁷⁶

The debut of the SARCOF consensus forecasts for the 1997/98 season must be evaluated within the context of this widespread media coverage. Nevertheless, many small-scale farmers had not heard of El Niño, or were made aware of it for the first time in the 1997/98 season. In fact, the case studies from Namibia and Tanzania indicate that many small-scale farmers did not receive any type of seasonal forecast for the 1997/98 growing season. Whereas approximately half of the farmers surveyed in April 1998 had received forecasts, a much smaller fraction of those surveyed later in the year claimed they had received forecasts. The discrepancy between the two surveys may reflect the timing of the surveys, or possibly confusion about the term “seasonal climate forecasts” and how they differ from regular weather forecasts.

Most of the farmers who did receive the forecasts heard them from the radio, or through informal sources such as neighbors. Unlike other end-users in the agricultural sector, such as commercial farmers, agricultural unions, credit institutions and marketing boards, the small-scale farmers who were surveyed were generally not connected to the information network within which the forecasts were distributed. The media coverage dedicated to El Niño probably inflated the number of farmers that heard some sort of seasonal forecast for the 1997/98 season.

6.1 Lessons from the Case Studies

Returning to the questions posed in the introduction, some conclusions can be drawn from these case studies with reference to the use of forecasts by small-scale farmers.

1. What is the role of forecast information in farmers' decisions regarding crop production?

The high value that farmers assign to the forecasts indicates that seasonal climate forecasts represent important information for small-scale farmers in Namibia and Tanzania. For many farmers, the seasonal forecasts may confirm the information derived from local indicators, such as changes in vegetation or animal behavior, or they may raise

⁷⁶ 18 April 1998, “Fewer expected to need food aid,” *The Herald*.

awareness about unexpected anomalies. The case studies suggest that the forecasts are currently used as no more than subsidiary information in crop production. Decisions about what, when and how much to plant are closely tied to the production options available or perceived.

Climate forecasts also influence farmers' decisions regarding crop production in more indirect ways. For example, hot and dry weather at the start of the planting season in key parts of South Africa's maize belt, along with fears that El Niño would result in a full-scale drought, led to a surge in maize prices in South Africa.⁷⁷ Credit availability was also affected by a fear of drought. The Agribank in Namibia insisted on more security to loans in relation to the previous year. The bank received fewer applications for loans in 1997/98, and granted only 20% of its normal loans to communal farmers.⁷⁸

2. What are the main constraints to optimal use of this information?

Whereas climate forecasts can potentially contribute to improved crop production and food security, production constraints must be simultaneously addressed in order for the potential to be fully exploited. Access to draft power, alternative seeds, fertilizers, credit, marketing opportunities, and other factors shapes the extent to which climate information can be used. These factors are influenced by a number of factors, including government policies, international agricultural markets, and structural adjustment programs. The efforts that are being expended to integrate climate forecasts into disaster relief and management could be matched with efforts to avert or mitigate disaster through increased options for pre-season adaptations to climate variability.

A number of factors relating to the information itself can also be considered constraints to forecast use. First and foremost was the timing of the forecasts. Although many farmers received the forecasts soon after they were released, others experienced a lag time of up to two months. Distributing the forecasts in a timely manner, as early as possible, would help farmers to make better use of the information, and possibly allow them to address some of the production constraints. Making the forecasts more understandable was also a concern for many. The presentation of probabilistic forecasts in terciles was considered to be somewhat esoteric for end users. Many farmers also expressed a desire for more detailed forecasts that included information about the timing and distribution of rainfall.

3. Which other factors influence farm-level planning and decisions?

The case studies showed that cultural and social factors play a visible role in terms of farm-level planning and decisions. A number of women responded that they were not in the position or did not have the power to make decisions regarding crop production. A reluctance to challenge the will of God was also mentioned by some farmers, along with faith in the divine intervention of God to produce rain, regardless of the forecasts. These factors suggest that it might be prudent to increase awareness and sensitivity to gender relations and religious beliefs in the distribution of climate forecasts.

⁷⁷ 7 December 1997, "SA maize prices surge," *Independent Farming* (Supplement to Zimbabwe Independent).

⁷⁸ Ronnie Bornman, Agribank, 7 April 1997. Conversation with Lars Otto Naess, Windhoek, Namibia.

4. How can the information be improved (e.g. in context or form) to help farmers maximize benefits?

To maximize the potential benefits of seasonal climate forecasts, farmers must receive the forecasts early enough, perceive it as reliable, and have the means available to take action. The skill, performance and interpretation of forecasts have not been communicated well enough to the community of “end users” in general. Because small-scale farmers have not been specifically targeted as end users (for example, through participation in SARCOF meetings), there has been very little communication and education about the forecasts. Among the agricultural institutions and farmers who were aware of the forecasts, there seem to exist unrealistic expectations as to the kind of information the forecasts can provide, how long in advance they can be made, and the level of temporal and spatial detail included in the forecasts.

There remains a mismatch between the climate forecasts and user needs. This mismatch can be summarized in the Table 17, which compares user needs with forecast capabilities and actual performance in the 1997/98 season.

Table 17. The 1997/98 SARCOF Forecasts: User Needs versus Seasonal Forecasts.

Factor	User Needs or Wishes (What is the ideal situation?)	Forecast Capabilities (What is the best they can do?)	Performance in 1997/98 (How did the forecasts do?)
Lead time	6 months before onset of rains	3 months before onset of rains	1.5-2 months before onset or rains
Information included in forecasts	Onset, total amount, and distribution on a weekly basis	Onset and total amount, distribution over a 3-month period	Probability of below average, normal or above average rainfall over a 3-month period.
Format	Greater than 70% confidence in one outcome	Depending on skill level, up to 70%	Forecasts for many areas were based on climatology (33-33-33)
Distribution	All should have access to the same information	A consensus forecast, interpreted and distributed through government agencies	Erratic distribution from the Weather Bureau to end users.
Perceptions	A trustworthy forecast	Lack of data limits the ability to evaluate forecasts	Performance difference between various parts of SADC
Ability to react on the basis of the information	Information about alter-natives and access to means to mitigate consequences	Limited role of SARCOF, can only give forecasts	Left to the ministries (with the exception of Tanzania)

Among institutions interviewed for this study, there seems to be a general agreement that seasonal forecasts can provide benefits to the region, and that the objectives of SARCOF are good. Seasonal forecasts enabled different organizations to plan for drought conditions and to coordinate drought contingency plans. The World Bank and other

lending institutions prepared loans in advance for countries that might have experienced crop reductions or failures due to El Niño.⁷⁹ Nevertheless, critical comments also emerged, largely concerning methodology, form, and information distribution and follow-up. Some of the major criticisms of SARCOF were that the forecasts did not adequately consider local knowledge, and placed too much emphasis on El Niño, and too little emphasis on regional influences. Others felt that the methodology for the consensus forecasts was premature, and that the way that the lines were drawn to distinguish regions seemed erratic and imprecise.

6.2 Regional Research on User Responses

To share experiences of research on user responses in other parts of southern Africa, a workshop was organized in Dar es Salaam, Tanzania (September 10-11, 1999) as part of the World Bank project on adaptations to climate variability. The objective of the *Workshop on User Responses to Seasonal Climate Forecasts in Southern Africa* was to present, discuss and compare research, primarily in relation to the agricultural sector of southern Africa. Participants brought a wide variety of perspectives to the workshop. The workshop agenda included the formulation of recommendations to take to the Southern Africa Climate Outlook Forum (SARCOF) meeting in Maputo, Mozambique, which was held the following week.

Two sets of issues emerged as important during the workshop. The first concerned communication and the development of information channels, and the second focused on constraints to the use of forecasts. Discussions suggested that the channels of dissemination from meteorological services to intermediate and end users remain quite weak throughout the region. In some countries, agricultural extension systems can promote the dissemination of forecasts, whereas in other countries, they are less effective. Although the radio is the most widely used media for forecast distribution in southern Africa, informal networks should not be underestimated. However, even if the forecasts were perfect (i.e., accurate and disseminated in an optimal manner), there would still be constraints to the use of the forecasts. These constraints are related to the limited availability of options, such as alternative seeds, draft power, irrigation, or availability of land. Identifying the constraints was seen as essential in understanding how coping strategies can be affected and strengthened by seasonal climate forecasts. Below, the major conclusions from the workshop regarding forecast dissemination and user responses are summarized.

Forecast Dissemination

- Farmers need the forecasts as early as possible. The SARCOF meetings should be held at the earliest possible dates that do not undermine or sacrifice the accuracy of the forecasts, and the forecasts should be distributed immediately after the meetings.
- A routine for information flow should be established using existing networks and institutions, rather than waiting for years with extreme forecasts to develop the network.

⁷⁹ 25 September 1997, "Banks prepare loans to aid El Nino-hit nations," *The Herald*.

- There are three distinct pathways that need to be addressed in the dissemination of forecasts (Figure 12).

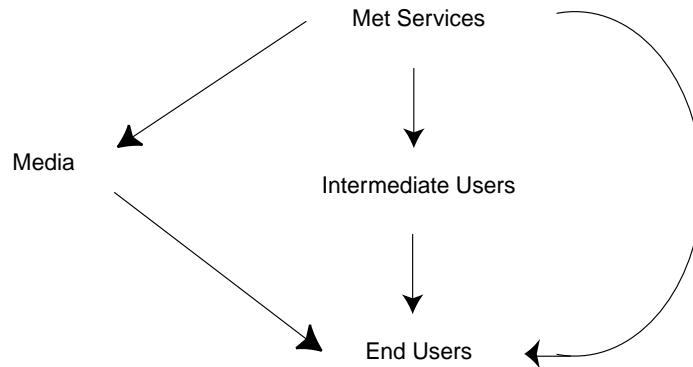


Figure 12. Information pathways for seasonal climate forecasts.

Note: Intermediate users can refer to any "transmitter" of information at the national, provincial, district or village levels.)

- All of the linkages are currently quite weak (in most countries). The first link, between met services and media is critical, and currently not functioning as well as it could. Regarding the other two pathways, bottlenecks need to be identified and broken.
- Radio is clearly the most important medium for communication for most farmers in southern Africa. Nevertheless, informal communication networks can be very useful and important.
- It is important that the end-users receive the "raw" climate forecasts and not only interpretations of the forecasts (i.e. advice or suggestions) so that they maintain control over their own decisions. In all communication efforts, it is important to emphasize the concepts of probabilities, skill, confidence and limitations.
- At the national level, regular (e.g. annual) meetings of meteorological services and representatives of various sectors should be encouraged, to establish a dialogue between the two where products can be presented and explained, and needs can be expressed.
- Researchers and forecasters need to be careful about language -- especially the tendency to interpret forecasts as a "good year" or a "bad year."
- There is a continual need to emphasize the distinction between "weather" and "climate" when disseminating the forecasts.
- Traditional or local indicators are widely used by farmers. More attention to these indicators, and their relationship to the model-based forecasts seasonal forecasts issued by meteorological services, is warranted.

- It is important not only to conduct and disseminate post-season evaluations of the forecasts, but also to explain the discrepancies, in order to build confidence in the forecasts.

Users Responses

- End users need to be identified and targeted.
- The common classification for farmers as end-users as either subsistence or commercial is too simple. A more sophisticated categorization is necessary, based on some combination of the parameters shown in Figure 14.

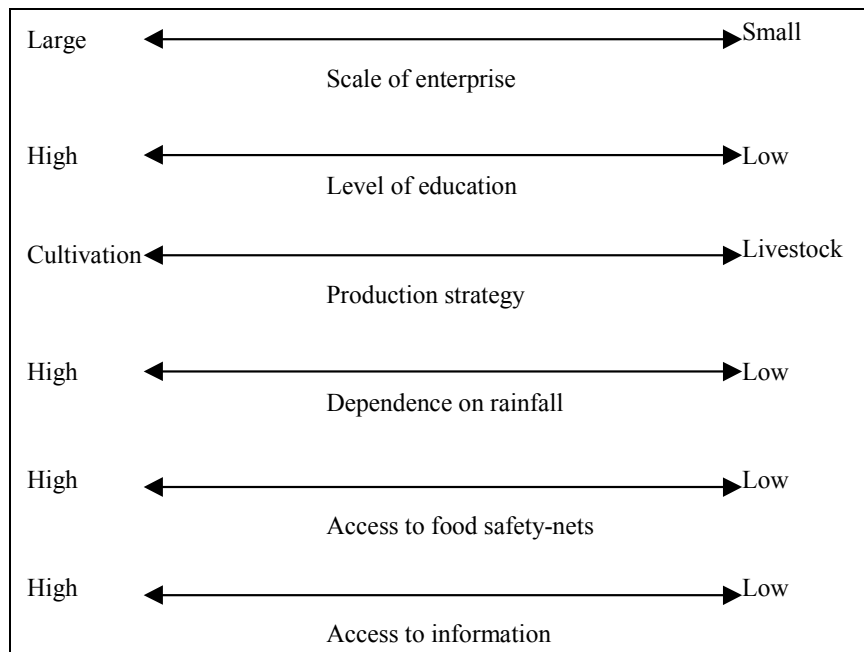


Figure 13. Parameters used to evaluate individuals in user-space.

Source: Blench, 1999

http://www.oneworld.org/odi/rpeg/weather_prediction/nrp_tanzania_workshop.htm

- To understand how different user groups will respond, researchers must make better use of the existing body of literature that describes the historical background and socio-economic context of present-day farming systems, as well as the literature on drought coping strategies.
- Case studies should focus on areas where the "context" literature is rich (i.e. where there exist background studies on agricultural production, drought or climate coping strategies, household socioeconomic surveys, etc.).
- Comparisons of case studies are valuable, but they require some consistency in methodology.
- Even if the forecasts were perfect (accurate and disseminated in an optimal manner), there are constraints to the use of the forecasts. Constraints can be

related to the availability of options, such as alternative seeds, draught power, irrigation, or availability of land.

- Identifying the constraints is essential towards understanding how coping strategies can be impacted by the use of seasonal climate forecasts. Addressing the constraints is critical for optimizing the potential benefits of climate forecasts.

6.3 Conclusions

In the wake of the 1997-98 ENSO event, there is a need to critically reflect upon the potential benefits of seasonal climate forecasts. Responses to present-day climate variability form the cornerstone for adapting to future climate changes. In the anticipation of changes in the frequency and/or magnitude of extreme events associated with global climate change, there is clearly a need for improved seasonal forecasts and better dissemination of the information. The objective of the study was to examine how seasonal weather forecasts, whether from SARCOF or other sources, were distributed, perceived, and used to take actions in the agricultural sector during the 1997/98 season.

SARCOF is seen by many in southern Africa as a development towards “one voice” for seasonal forecasts. In earlier years, forecasts were distributed from several international sources, and the information was often difficult for many farmers to obtain. What could be improved? There seems to be a need for a more formal co-ordination of forecast dissemination between the meteorological services (“the distributor”), the institutions and agricultural government agencies (“translators” or “intermediate users”), and farmers (“end-users”). Leaving the information flow to informal channels alone will result in erratic distribution, with little possibility for monitoring and follow-up. Formal information channels can be used more effectively for distributing the information.

SARCOF has created opportunities as well as challenges for southern Africa. Opportunities emerge because the forecasts contain useful information that could potentially yield benefits to a variety of sectors depending on contingency planning over a season or more. Agriculture is the single most important of such sectors in southern Africa. Challenges arise from the fact that forecasts must be treated with caution. Probability-based forecasts can seldom be wrong, and they should not be confused with deterministic forecasts. Furthermore, large interests are at stake, and the failure of forecasts to provide an accurate representation of the season’s climate could have large negative consequences, be it economic, social and political, for those producing forecasts, as well for those as those putting their faith and resources behind the forecasts.

The greatest challenge to the expanded use of seasonal climate forecasts lies in improving the capacity of small-scale farmers to respond flexibly to the climate forecasts. Draft power, seed prices and availability, access to credit, crop prices, and transportation prices are important factors influencing production in communal farming areas of Namibia. These serve as potential constraints to the use of forecast information. Addressing these constraints, in combination with improving the timing and reliability of the forecasts, can help farmers to make better use of the information included in forecasts as a means of coping with climate variability and long-term climate change.

This study shows that climate forecasts have the potential to increase food security in southern Africa. However, the full benefits will not be realized until farmers regularly receive the forecasts, and, most importantly, have a wider range of response strategies for coping with climate variability. Thus the results of this study caution against a misplaced

emphasis on improving the accuracy of forecasts at the expense of increasing the flexibility of farmers to adapt to climate variability and change. Moreover, they point to a need to examine how economic changes taking place in southern Africa enhance or constrain this flexibility. Seasonal climate forecasts can serve as more than a tool for emergency management of food aid. Addressing the economic constraints to the use of seasonal climate forecasts could place farmers in a position where they could actually act upon the information. Information alone is not enough, but combined with increased attention to response strategies, seasonal climate forecasts can serve as a valuable tool for farmers in southern Africa.

Appendix I

Institutional Interviews

Interviews were carried out with the following institutions during fieldwork in April, 1998:

Namibia

- Namibia Meteorological Services
- Ministry of Agriculture, Water and Rural Development
- Department of Water Affairs
- Department of Agriculture
- Namibia Early Warning System
- Desert Research Foundation of Namibia
- Oxfam Canada
- Namibia Agricultural Union
- Agronomic Producers Board
- Meat Board of Namibia
- Emergency Management Unit, Office of the Prime Minister
- Agribank
- Meatco

Tanzania

- Directorate of Meteorology, Dar es Salaam
- Institute of Housing and Building Research, Dar es Salaam
- Tanzania Seed Company
- Morogoro Primary Farmers Cooperation Society
- Regional Agriculture Office, Extension Service
- Farm Care, Morogoro
- Ministry of Agriculture and Cooperatives
- Department of Agriculture
- Food Security Department

Zimbabwe

- Department of Meteorological Services
- Drought Monitoring Centre
- Environment and Remote Sensing Institute, SIRDC
- Famine Early Warning System, Zimbabwe
- Commercial Farmers' Union of Zimbabwe
- ZFC Ltd.
- Windmill, Ltd.
- Zimbabwe Farmers Union
- FAO/SADC Regional Remote Sensing Project
- Seedco
- Indigenous Commercial Farmers Union
- World Vision International, Southern Africa Region
- Zimbabwe Tobacco Association
- National Early Warning Unit/Agritex

Appendix II

**Workshop on User Responses to Seasonal Climate Forecasts in Southern Africa
Dar es Salaam, Tanzania
September 10-11, 1999**

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Appendix III

Questionnaire from Second Survey

Date: Questionnaire
 no.:
 Location (region, district, village): Interviewer:

 Name of respondent (optional):
 Age:
 Gender:
 Type of farm (e.g. private, resettlement, communal):

1. Farm size: (specify hectares/acres)
2. Household size: persons
3. Type of labor employed on farm

Family	Hired (seasonal)
Neighbors	Other (specify)
Hired (full-time)	
4. Number of people working on farm during cropping season: persons

5. Main crops:

Crop	Area (hectares/acres)	% marketed	Crop	Area (hectares/acres)	% marketed
a) Maize			i) Bananas		
b) Sorghum			j) Coffee		
c) Millet			k) Tea		
d) Cassava			l) Beans		
e) Cowpeas					
f) Cotton					
g) Groundnuts					
h) Rice					

6. How large a share of your income normally comes from agriculture: about..... %
7. Other sources of income:

a) Livestock	d) Wage labor
b) Commercial business	e) Fishing
c) Handicrafts	f) Other (specify)
8. Has the weather been "normal" this year (1997-1998)?
 - a) no
 - b) yes
 Please explain:
9. Were there any early signs that the weather this year (1997-1998) would be different?
 - a) no
 - b) yes
 If yes, please describe
10. What is the most recent year/season (before 1997/98) you can remember with extreme weather conditions?
 19....
11. How was the 1997/98 season compared to that year?

a) Temperature:	warmer	cooler	no difference	can't remember:
b) Rainfall:	wetter	drier	no difference	can't remember
c) Other, please describe:			
12. Did you receive any pre-season weather forecasts for this past spring/summer (1997/98)?

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- a) no
- b) yes

If “no,” please go to question 23.

If “yes”, please answer the following:

13. When did you first hear this forecast? Please specify month and year (MM/YY)

14. What was the source of this information? If there was more than one source, please check all that apply, and circle the one you consider most reliable.

- a) Meteorological bulletins
- b) Newspaper
- c) Radio
- d) Television
- e) Agricultural extension agency
- f) Neighbors
- g) Aid organisations
- h) Religious organisations
- i) Internet
- j) Village meeting
- k) Other, please describe

15. Please describe the forecast.....
.....
.....
.....
.....

16. Did you believe in the forecast?
a) no Please explain why not

b) yes Please explain why

17. Did the forecast contain enough information to make planning decisions?
a) no Please explain why not

b) yes Please explain why

18. Was the information relevant for your needs?
a) no Please explain why not

b) yes Please explain why

19. What did you do differently, given the forecasts? (In other words, did the forecasts change or alter any of your routines, activities, or operating procedures?) Please describe.

- a) changed crop types: from to
- b) changed planting dates: from to
- c) changed crop locations: from to
- d) changed irrigation routine:
- e) changed amount planted (specify %): more of less of
- f) sold livestock: if so, when?
- g) no changes were made (explain why not):
- h) other (explain).....

20. Looking back, would/could you have done anything differently before the season if you knew in advance how the weather was going to be?

- c) no Please explain why not
- d) yes Please explain what actions

21. Did you use the pre-season forecasts to prepare for potential emergencies? (droughts, floods, food shortages)

- a) no Please explain why not
- b) yes Please explain why and how

22. Were the forecasts eventually representative of the actual situation?

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- a) no
 - b) yes
-

23. Did you hear updated long-term forecasts during the rainfall season?

- a) no
- b) yes

If “no,” please go to question 32.

If “yes”, please answer the following:

24. When did you hear forecast(s)? Please specify month/year for all the times you heard forecasts during the season (MM/YY)

.....
.....

25. What was the source of this information? If there was more than one source, please check all that apply, and circle the one you consider most reliable.

- | | |
|----------------------------------------|----------------------------------|
| a) Meteorological bulletins | g) Aid organisations |
| b) Newspaper | h) Religious organisations |
| c) Radio | i) Internet |
| d) Television | j) Village meeting |
| e) Agricultural extension agency | k) Other, please describe |
| f) Neighbors | |

26. Please describe the forecast:

.....
.....
.....

27. Did you believe in the updated forecast?

- a) no Please explain why not
- b) yes Please explain why

28. Did the forecast contain useful information?

- a) no Please explain why not
- b) yes Please explain why

29. Did you change any of your farming activities due to the forecast?

- a) no Please explain why not
- ...
- b) yes Please explain which activities and what changes were made

30. Did you use the forecasts to prepare for potential emergencies? (droughts, floods, food shortages)

- a) no Please explain why not
- b) yes Please explain why

31. Were the mid-season forecasts eventually representative of the actual situation?

- c) no
 - d) yes
-

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32. Did or will any of the following external changes affect your production this year? Please explain.

- | | |
|----------------------------------------|-------------------------------------------------|
| a) changes in credit availability..... | e) changes in seed prices or availability |
| b) changes in crop prices | f) changes in fertilizer prices..... |
| c) changes in marketing options..... | g) changes in pesticide prices |
| d) changes in transport prices | h) other: |

Comments:

.....

.....

.....

33. What type of yields did you get this year? Please indicate with the following symbols:

- above average: +
- average: 0
- below average: -

<i>Crop</i>	<i>Yield</i>	<i>Crop</i>	<i>Yield</i>
i) Maize		q) Bananas	
j) Sorghum		r) Coffee	
k) Millet		s) Tea	
l) Cassava		t) Beans	
m) Cowpeas		u)	
n) Cotton		v)	
o) Groundnuts		w)	
p) Rice		x)	

34. How has this year's weather affected your production? (i.e., positively, negatively, or no difference?) Please explain.

.....

.....

.....

35. Did you receive any relief or aid this year, or do you anticipate receiving any (please explain)?

- a) no
- b) yes
- If yes, which source(s):.....

36. How useful do you consider long-term weather forecasts for planning of your farming activities? Please circle: 1 = not useful, 5 = very useful

1 2 3 4 5

Please

explain:.....

.....

37. Would you prefer any changes to today's forecasts? (e.g.: when forecasts are published, how often, forecasts for how many months in advance, etc.)

.....

.....

.....

38. How will you react next time you hear that an "El Niño" is coming?

.....

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