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THE IMPACT OF RAINFALL VARIABILITY ON RAIN-FED TOBACCO IN MANICALAND PROVINCE OF ZIMBABWE

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ABSTRACT

The aim of this study was to assess the impact of rainfall variability on tobacco production in Nyazura district of Manicaland in Zimbabwe between 1999 and 2009. Tobacco, which is the most important cash crop and a major earner of foreign currency in Zimbabwe, is thought to be one of the crops severely affected by climate change especially in Nyazura district. However, no study has been carried out to assess the relationship between tobacco production records and climate change especially rainfall variability over the years. Questionnaires and interviews were used in data collection. Questionnaires were distributed to farmers and Agricultural Research Extension (AREX) officers were interviewed. Secondary data was obtained from the Meteorological Department, the Central Statistical Office, and the Tobacco Sales Floor. Rainfall data from the district was correlated with tobacco yields data from the same district. The result from the correlation co-efficient showed there is a positive correlation between tobacco yields and the amount of rainfall. The study showed that among other causes, rainfall variability is a major factor influencing the decline in yield and farmers are very much aware of climate variability in their district. There is need for resource mobilization to fund community-based projects such as borehole drilling, irrigation, and cultivation of tobacco cultivars which are drought tolerant.

Keywords: Rainfall Variability; Climate Change; Tobacco Yield; Drought

INTROUCTION

This paper examines the impact of rainfall variability on rain-fed tobacco production in Nyazura district of Manicaland Province of Zimbabwe. Nyazura lies to the east of the country at an altitude of 800 meters (m) to 1 219 m above sea level, 18^0 40's latitude and 32^0 16' E longitudes. The district was chosen because it is an important contributor of tobacco in the country and that the communal farmers in the district survive on tobacco farming. Nyazura has a population of 13 800 people who depend on farming for a living. It is located 67 km from Mutare, along Mutare- Harare highway. Nyazura receives an average rainfall of between 600mm and 800mm per annum and tobacco is widely grown as the most important cash crop compared to maize and cotton. Flue-cured is the type of tobacco grown in Nyazura, and it falls in the Virginia RK26 group which is a relatively new root-knot resistant variety. Tobacco requires about 20mm to 30mm rainfall after every two weeks.

According to Makarau and Zhakata (2000), Zimbabwean tobacco production has dropped by 4% in recent years. The production of tobacco continues to be precarious and this has a bearing on the livelihood of the farmers and the country's exports.

Zimbabwe's agriculture is heavily dependent on natural rainfall (Burroughs, 2001). In the communal areas of Zimbabwe, agriculture is largely controlled by rainfall conditions. In these areas most elements of climate, particularly temperatures, are very uniform both over place and time, but rainfall is exceptionally variable. Its variability especially in summer is a major determinant of crop output per unit area particularly in the communal areas where farmers dependent on it for their survival. Studies undertaken in Australia further support the assertation that a strong connection exists between wheat yields and rainfall variability. Thus the study of rainfall variability is significant in the context of agricultural production and climate change.

The greatest challenge facing developing countries today is improving agricultural production to eliminate hunger and poverty (Nhemachena, 2003; Parry, 1978; Parry, 1981; Youdeowe, Ezdina and Onazi, 1986). The importance of precipitation to the national economy is well known, there is no branch of the economy that is not affected either directly or indirectly by this factor (Battalov, 1971). As such, efforts to better understand the impacts of climate on agriculture are important where development and poverty alleviation are concerned. Furthermore, it has been recently observed that adapting to climate change is the best way of realizing sustainable agricultural output for those communities that are dependent on rain fed agriculture (Sultan, Baron, Dingkuhn, and Janicot, 2004; Robinson and Henderson, 1999).

According to the World Meteorological Organisation (WMO) report on Zimbabwe (2007) rainfall is by far the most important variable that affects crop production. Although there are different results from different studies, most assessments indicate that climate variability would have negative effects on agriculture. Tobacco, which is the most important cash crop and a potential major earner of foreign currency in Zimbabwe, is one of the crops severely affected by climate change particularly in Manicaland Province. However, no study has been carried out to assess the relationship between tobacco production records and climate change especially rainfall variability over the years. Decreased tobacco yield output results in disastrous effects not only to the farmers, but also to other sectors of the national economy such as agro-processing. Surprisingly, very little is known about rainfall variability and its impacts on tobacco in Nyazura. It is against this background that the study sought to assess the relationship between rainfall variability and tobacco yield in Nyazura between the years 1999 and 2009 so as to establish the major causes of decline in yield and to come up with recommendations for sustainable tobacco output in the area.

DATA SOURCES

The data on tobacco yield for Nyazura was obtained from archival statistics on tobacco production since 1999 from the Tobacco Research Board, AREX (Agricultural Research Extension) and the Central Statistical Office (CSO). Rainfall and temperature data was obtained from the Meteorological Services Department of Zimbabwe. The climatic parameters and tobacco yield output were then analysed and correlated using Windows Excel. In order to incorporate the views and

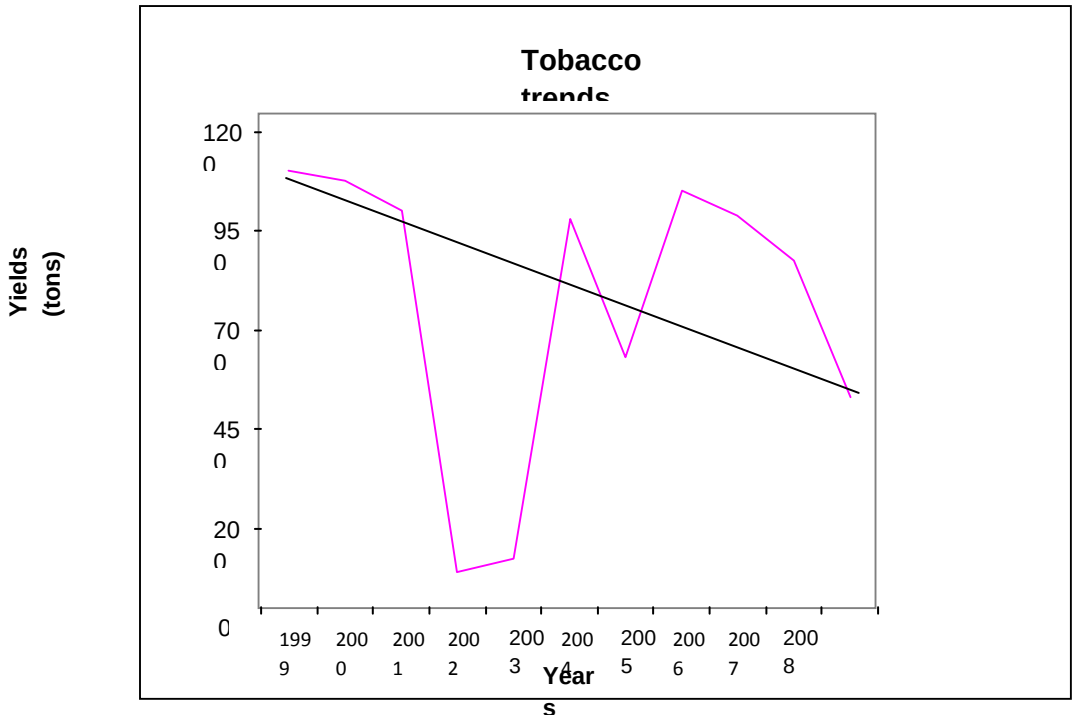
experiences of farmers on rainfall variability and the impact on tobacco production, interviews were conducted using questionnaires. The data obtained from the questionnaires was analysed manually to determine the number of farmers who held the same views on a particular topic. Twenty tobacco farmers were selected for the interview from the district all of whom had at least five years of experience in this field.

RESULTS AND DISCUSSION

Changes in total tobacco yield in Nyazura.

There has been a general decrease in the amount of tobacco produced in Nyazura since 1999 (Figure 1). The yield has declined despite the fact that there has been an increase in the number of farmers and the area of land under tobacco. The highest yield of 1102, 5 tons was obtained during the 1999/2000 season. Tobacco production trends in the district have remained precarious with yield declining to 90, 7 tons in the 2001/2002 seasons. The actual yield is characterised by fluctuations in production, the decline being caused by decrease in rainfall.

Figure 1: Trends in total tobacco yield produced in Nyazura (1999-2009).

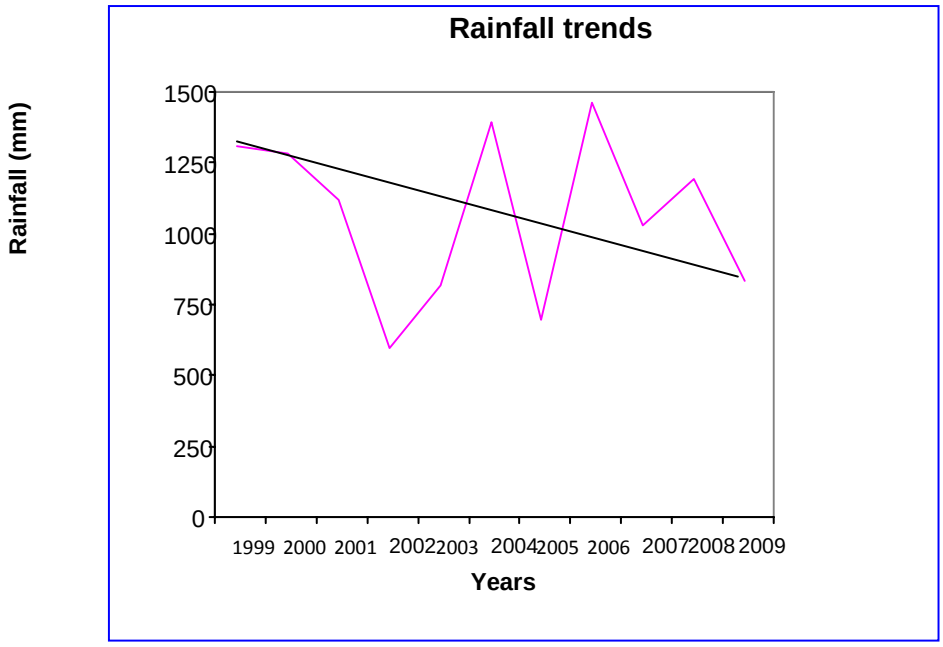


Source: Tobacco Sales Flow (2010)

Rainfall variability in Nyazura between 1999 and 2009

Rainfall in Nyazura is highly variable and the district was affected by large extremes of rainfall in the years 1999-2000 (1296.65 mm), 2003-2004 (1379.4 mm), and 2006-2007 (1175.5 mm). This is not conducive for good rain-fed agricultural production. A gradual decline in rainfall occurred as shown in Figure 2, having some extreme declines in 2001-2002 (578.5 mm) and 2004-2005(682.65 mm) seasons.

Figure 2 Rainfall trends in Nyazura: 1999 to 2009

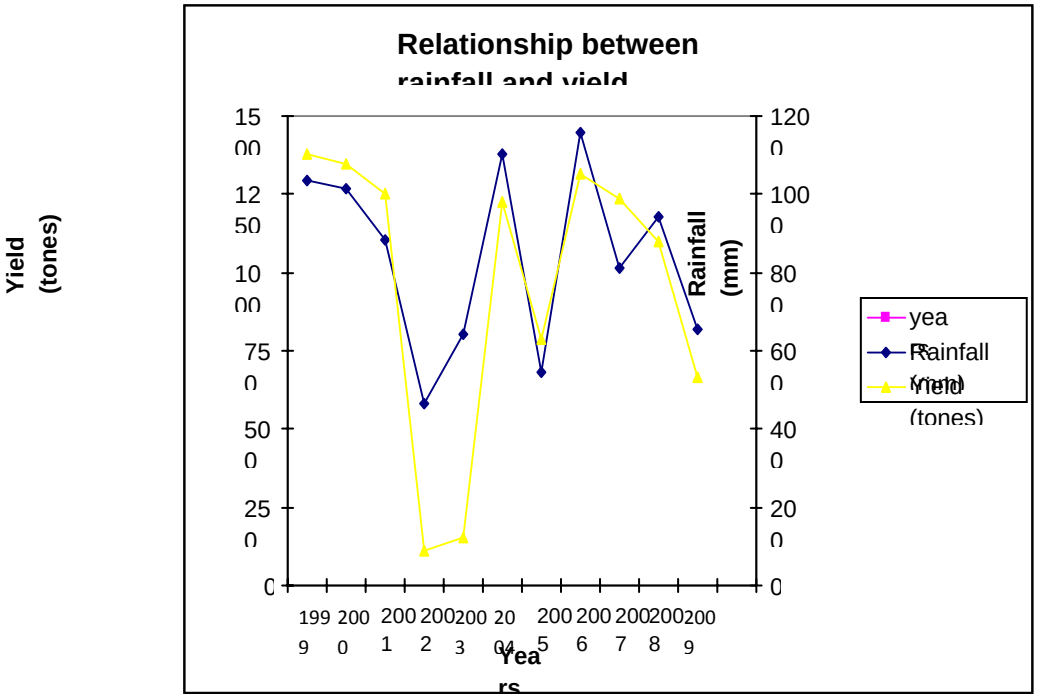


Source: Meteorological Services Department of Zimbabwe (2010)

Seasonal rainfall totals and tobacco yield

To assess the relationship between rainfall variability and tobacco yields, a correlation analysis between rainfall seasonal totals and total tobacco yield from Nyazura was made. The analysis produced a +0.6 correlation co-efficient confirming the assertion that rainfall variability directly affects tobacco yield output in Nyazura. A decrease in rainfall translates to a decrease in yield assuming other factors such as temperature, soil fertility and inputs availability remain constant. On the other hand an increase in rainfall translates to an increase in yield. Tobacco yield changes in resonance to the variability of rainfall and thus shows a strong relationship between rainfall and tobacco yield in Nyazura confirming the assertion that rainfall variability is the major factor for the decline in yield in the district as shown in Figure 3.

Figure 3 Tobacco yield and rainfall variability trends.



Source: Field data (2010)

Temperature and tobacco yield

The data analysis for temperature and yield also revealed interesting results. The data analysis has shown those temperature and tobacco yields are negatively correlated. A rise in temperature loosely translates to a decrease in tobacco yield. Table 1 shows that an increase in temperature results in a significant reduction in tobacco yield in Nyazura. High temperatures encourage evapotranspiration, affecting plant growth in the absence of adequate soil moisture.

Table 1: Tobacco yield and maximum average temperature for growing season

Years	Maximum average temperatures for growing season (^{o}C)	Yield (tons)
1999	28.02	1102.5
2000	27.97	1078.6
2001	28.09	1003.5
2002	31.12	90.7
2003	30.19	120.5
2004	29.88	980.9
2005	29.38	630.8
2006	28.65	1052.7
2007	30.58	990.6
2008	30.67	877.4
2009	30.74	530.5

Source: Makoni Statistical Records (2010)

Rainfall Variability: Local Experiences

In Zimbabwe the threat posed by rainfall variability has not been taken seriously. The extent and nature of the impact has not been studied adequately and very little is known about the extent of the damage that has been caused by climate change and rainfall fluctuations. Makarau and Zhakata (2000) also assert that rainfall is a highly variable climatic parameter both inter-annually and intra-seasonally. However, in spite of its significant contribution to agriculture, these oscillations have not been examined fully.

Zimbabwe‘s agricultural sector currently represents the largest force driving the country’s economy. Agriculture is mainly dependant on climatic conditions and this makes it extremely vulnerable to climate change. In Zimbabwe, climate is characterised by a history of rainfall fluctuations of varying lengths and intensities. Periods of floods and prolonged dry spells have characterised the majority of rainfall seasons in the country. Floods in the country result mainly from cyclones and have caused wide spread damage to crops and infrastructure. Cyclone Eline and Cyclone Japhet induced floods resulting in many people being left homeless with the majority of their maize crop destroyed.

According to Hulme and Sheard, (1999) there has been an overall decline of about 5% in rainfall across Zimbabwe during the last century. Since 1976 there has been a tendency of the El Nino warm phases of the ENSO to dominate resulting in reduced rainfall occurrences over the country (Hulme & Sheard, 1999). The El Nino-Southern oscillation is one of the main causes of rainfall variability over Zimbabwe. If the perceived trends of a warming climate and reduced rainfall are anything to go by, then Zimbabwe due to its continental location is expected to experience warmer temperatures than other areas (Hulme &

Sheard, 1999). Furthermore a decrease in rainfall is anticipated over the whole country. The result of this is poor agricultural production and that affects an economy that is heavily sustained by agriculture. This requires adaptation strategies to be formulated that range from policy, technical and community involvement strategies.

Zimbabwe's Agriculture

Agriculture is the backbone of Zimbabwe's economy providing for over 50 percent of the Gross Domestic Product. Zimbabwe has not yet sustained food self-sufficiency; on the contrary, an underdeveloped subsistence livestock sector and declining crop yield levels threaten the livelihood of the present population of about 12.8 million people and the availability of natural resources to future generations.

Crop and livestock production depend on rainfall as the sole source of water supply and less than 5 percent of arable land is under irrigation. In the last three decades, the country has experienced variability of seasonal rainfall. There have been three significant droughts (in 1978- 79, 1981- 82, and the worst one being the 1991- 92 seasons), frequent and increasingly long dry spells, and erratic onset and cessation of rainfall seasons. Even with fair or excellent rainfall in those zones, no one would know when to expect which kind of season. Thus, the risk of failure of the more desired crops and pasturage is high and unavoidable, threatening the county's economic well being. It is envisaged that the anticipated global climate change will alter temperature and rainfall levels in most areas. These changes, with increased fluctuations, are expected to cause many shifts in agricultural production. Most crops are sensitive to changes in climatic conditions, including alterations in temperature, moisture, and carbon dioxide levels. Furthermore, major climate changes influence the populations of beneficial organisms and pests and alter their effective roles in agricultural ecosystems.

Tobacco Production in Zimbabwe

Tobacco is Zimbabwe's most important export crop followed by cotton and 65% of the crop is from the smallholder sector. It has been noted for sometime that national productivity has been on a downward trend since the 1990's. This has had negative effects not only to the farmers who solely depend on tobacco, but also to the national economy at large. Battalov (1971) asserts that there is no branch of the economy that is not affected either directly or indirectly by precipitation, thus the study of rainfall fluctuations is of scientific and practical importance.

Nyazura, both east and west is one of the largest producers of tobacco in Zimbabwe (Nyambara, 2003). Its production of tobacco surpasses other districts by far and it accounts for the larger proportion of total tobacco output from Zimbabwe. Flue current is the type of tobacco grown in Nyazura, and flue current falls in Virginia RK26 group. Tobacco needs about 20 mm to 30 mm rainfall after every two weeks. Tobacco farming in Nyazura grew faster than in any other area due to the favourable weather conditions. Its importance is judged by the fact that it accounts for 30 percent of the cropped area compared to 5 percent in other tobacco growing areas (Nyambara, 2003).

The most suitable areas for tobacco production in Zimbabwe are below an altitude of 1400 metres having deep fertile, and medium to heavy soils. In general, the lower the altitude the more favourable are the growing condition provided that water is

available. This makes Nyazura a suitable place for farming tobacco. However, the swings in rainfall and the extent of the impact have not been studied adequately. According to the Zimbabwe Meteorological Services Department (1981) Nyazura lies at an altitude of about 1482 m above mean sea level. With maximum average temperatures of 27^{o}C for the growing season, Nyazura's climate is suitable for tobacco production. However, with a rainfall variability of less than 30% its climate is highly variable and as such presents problems for rain-fed agriculture. It is with this in mind that the study sought to understand the extent of the impact on tobacco production in the district to come up with mitigation strategies that will improve yield output.

Doorenbos and Kassam (1986) assert that tobacco is grown extensively under rain-fed conditions across the globe. It is thus vulnerable to the vagarities of rainfall extremes especially in Sub Saharan Africa where the rainfall is highly variable. Zimbabwe, which is an agro-based economy, is directly affected by rainfall variability and resulting in low yields and spells hunger for the farmers and the nation at large. Indirect effects are felt in down stream industries such as manufacturing. Richardson (2007) confirms this view and asserts that a strong correlation exists between tobacco yield and rainfall in Sub Saharan Africa. He ascribes the recent collapse of the Zimbabwean economy to the lack of rainfall.

The greatest challenge that faces many developing countries is the need to eliminate hunger and overcome extreme poverty (Youdeowe et al 1986). Investing in rain-fed farming systems is of paramount importance if hunger and poverty are to be eradicated. Understanding the impacts of climate, particularly rainfall variability, is of paramount importance if successful crop husbandry is to be realized (Youdeowe, Ezdinm, & Onazi, 1986).

CONCLUSION

The results revealed that tobacco yield in Nyazura district of Manicaland is correlated to rainfall variability. The trends in tobacco output are in unison with changes inter annual rainfall patterns showing a strong correlation between the two variables. Of particular interest is the 2002/3 season, which showed clearly how rainfall can affect production under dry land conditions. Maximum temperatures and tobacco are negatively related. When temperature increases, yield declines and when temperature decreases yield increases. This is because during the summer season in Zimbabwe a drop in the maximum temperatures is usually a result of higher rainfall and cloudiness. The availability of rainfall usually translates to good yield, other factors being equal. Thus temperature in Nyazura does not affect tobacco yield and cannot be taken to affect tobacco production.

The temperature regime for the district indicated that there is a general rise in maximum temperatures for the study area. This is in unison with the findings of Hulme and Sheard (1999) that Zimbabwe is experiencing significant warming. The study revealed the threat posed by climate variability and change and hence the need for more concerted effort in reducing the impact of the phenomena. The majority of farmers are aware of the declining rainfall and how it has affected tobacco yield. Farmers also indicated that farmer-training initiatives coupled with adequate and affordable farming inputs can reduce the problem of yield decline.

RECOMMENDATIONS

The tobacco sector in Manicaland province of Zimbabwe needs to be overhauled if the current trends in production are to be reversed. There is need for resource mobilization to fund community-based projects such as borehole drilling, irrigation, and cultivation of tobacco cultivars that are drought tolerant. Government needs to implement water harvesting projects to supplement rainfall and also to enable longer growing seasons for tobacco. Farmers need to be effectively trained on how to grow tobacco. More-over, women should also be trained how to grow and manage tobacco under dry conditions. There is also need for more research on tobacco varieties, especially those that are drought and pest resistant. Effective early warning systems need to be developed as well as crop calendars for farmers.

REFERENCES

Battalov, F.Z. (1971). *Long Term Fluctuations of Atmospheric Precipitation and Computation of Precipitation Averages*. Jerusalem: Greenberg.

Burroughs, W.J. (2001). *Climate Change, A Multidisciplinary Approach*. Cambridge: Cambridge University Press.

Doorenbos, J. and Kassam, A.H. (1986). *Yield response to water*. FAO Irrigation and Drainage, paper 33, Rome.

Hulme, M. and Sheard, N. (1999). *Climate Change Scenarios for Zimbabwe*. Norwich, UK: Climate Research Unit.

Makarau, A. and Zhakata, W. (2000). *Meteorology and Climatology*. Harare: Zimbabwe Open University.

Meteorological Services Department. (1981*). Climate Handbook of Zimbabwe.* Met Department, Harare.

Mutizwa- Mangiza, N.D. (2006). *Rural Local Government Finance in Zimbabwe*. The case of Nyazura District Council. Retrieved from www.interscience.wiley.com 23 October 2010.

Nhemachena, M.R. (2007). Assessment of the economic impacts of Climate Change on Agriculture in Zimbabwe: A Ricardian Approach. NPSS 4292 Vol. 1 of 1.

Nyambara, P. (2003). *Rural Landlords, Rural tenants and the Sharecropping Complex in Nyazura, Northwestern Zimbabwe, 1980-2002*. University of Zimbabwe, Harare. Retrieved from www.wisc.edu on 5 February 2010.

Parry, M.L. (1978). *Climate change, Agriculture and Settlement.* Folkestone, UK: William Dawson and Sons.

Parry, M.L. (1981). *Climatic change and the agricultural frontier: A research strategy.* In: Climate and History, (319-336). Cambridge: Cambridge University Press.

Richardson, C.J. (2007). *How much did drought matter? Linking rainfall and GDP growth in Zimbabwe*. Retrieved from www.afref.oxfordjournals.org. 5 February 2010.

Robinson, P.J. & Henderson–Sellers, A. (1999). *Contemporary Climatology*. England: Pearson.

Sultan, B., Baron, C., Dingkuhn, M. and Janicot, S. (2004). Agriculture Impacts of regional Variability of the Western African monsoon. Retrieved from www.sciencedirect.com on 20 March 2010.

World Meteorological Organisation. (1971). *Agroclimatology in The Semi Arid Areas South Of The Sahara.* Proceeding of the Regional Technical Conference, Dakar.

World Meteorological Organisation. (2007). Climatology. Retrieved from www.wmo.ch/pages/prog, on 23 March 2010.

Youdewe, P., Ezdinma, F.O.C., and Onazi, O. (1986). *Introduction to Tropical Agriculture.* England: Longman.

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