

THE IMPACT OF CLIMATE CHANGE ON THE AVAILABILITY AND CONSUMPTION OF INDIGENOUS VEGETABLES IN LIMPOPO PROVINCE, SOUTH AFRICA

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ABSTRACT

Climate change threatens the livelihood of rural communities that depend on natural resources for food. Many people in developing countries living in the rural areas depend on indigenous food resources which in years are scarce and in poor supply as a result of marginal and erratic rainfall, low soil and ambient temperatures below the minimum temperature. Consumption of indigenous vegetables is among the indigenous livelihood patterns that are declining due to erratic rainfall patterns, excessive heat and persistent drought. The present study examined the implications of climate change on the availability and consumption of indigenous vegetables in Dikgale community in Limpopo Province, South Africa. Focus group discussions with a sample of 100 informants revealed awareness of change in climatic conditions in the form of erratic rainfall patterns and excessive heat. The implications of this change have led to the scarcity of indigenous vegetables and their rare consumption.

Keywords: Climate change, Natural resources, Livelihood, Indigenous vegetables, Rural community.

INTRODUCTION

The indigenous livelihood patterns of rural communities are dependable upon available natural resources in their local environment (Food and Agricultural Organisation [FAO] 2008). Shackleton et al. (2002), Ramakrishnan (2001) and Cavendish (1999) confirm that natural resources play a significant role in indigenous livelihood patterns of rural communities. These livelihoods are negatively affected by intensified environmental changes in the form of pollution, ecosystem degradation and loss of biodiversity. Rural communities in South Africa are vulnerable to these hazards because of their dependency on climate sensitive economies and high levels of poverty (Madzwamuse 2010). Remarkable manifestations of environmental changes are drought, soil erosion, dry grasslands and loss of biodiversity (Turpie et al. 2002; SANBI 2011; Zhu & Ringler 2010).

Hachileka and Vaatainen (2011), Mapaure et al. (2011), Maponya and Mpandeli (2013) and Zier vogel et al. (2014) maintain that environmental change is brought about by climate variations in the form of excessive

heat and erratic rainfall patterns (Dowing 1992; Bhusal 2009). Remarkable changes in temperature patterns were reported between the years 1960 and 2009 where the mean annual temperature increased by at least 1.5 times the observed global average of 0.5°C over the past five decades (Ziervogel et al. 2008), which resulted in the frequency of windy weathers, increased heat and drought (Maponya & Mpandeli 2012).

About 70% of people in developing countries living in rural areas depend on indigenous food resources (Dube & Phiri 2013; Madzwamuse 2010; Nethononda & Odhiambo 2011; Vermeulen et al. 2012) which are recently characterized by higher degrees of scarcity and poor supply (Madzwamuse 2010) as a result of marginal and erratic rainfall, low soil and ambient temperatures below the minimum temperature of 10 °C (Dube & Phiri 2013). Subsistence farmers are vulnerable to the impacts of increased temperature (Huq et al. 2015) and drought (Ziervogel et al. 2014; SANBI 2011) which are among the recent pervasive stressors rural communities have to cope with (Maponya & Mpandeli 2013) to get food.

Excessive heat and unpredictable rainfall threaten the livelihood of rural communities which depend on natural resources for food (Intergovernmental Panel on Climate Change [IPCC] 2007). Mwingira et al. (2011) add that rising temperatures are expected to threaten biodiversity and productivity of natural resources. For FAO (2008), the impact of climate change will threaten the food and water resources in Sub-Saharan Africa. This is especially true for communities that live in the drylands of Africa, who rely wholly on rain-fed agriculture for their livelihood (Zhu & Ringler 2010). Furthermore, Dube and Phiri (2013) show that rural livelihoods in Zimbabwe revolve around food production mechanisms which are rain-dependent and any negative change in rainfall patterns is likely to impact negatively on food provision systems.

The members of rural communities are aware of devastating changes in their living conditions such as malnutrition, poverty, water and air contamination, increased risks of disease, floods, soil erosion and depletion of biodiversity as a result of climate and environmental variability (IPCC 2007; Gandure et al. 2011). These communities are also aware of the negative impacts of this change on their livelihoods (Mwingira et al. 2011; Nhemachena et al. 2014; Thompson et al. 2012). Additional evidence provides temperature and rainfall variations already threatening the livelihood of rural communities (Thompson et al. 2012; Maponya & Mpandeli 2012; 2013; Quinn et al. 2011; Ziervogel et al. 2006). Consumption of veld fruits and vegetables is among the livelihood patterns negatively affected by erratic rainfall patterns, excessive heat and persistent drought (Dube & Phiri 2013; Maponya & Mpandeli 2012; 2013).

This paper examined the implications of climate change on the availability and consumption of indigenous vegetables in Dikgale rural community in Limpopo Province, South Africa. The choice of Limpopo Province is against

the background that it is the most vulnerable part of the country in which rural communities continue to exploit natural resources for food and medicine (Mabogo 1990; Rasethe et al. 2014; Semenya & Maroyi 2012). The results of the study could be used to encourage community members develop mitigation and adaptation measures to cope with the impacts of climate hazards on the availability of indigenous vegetables to sustain the livelihoods.

METHODOLOGY

Study locality

The study is based on fieldwork conducted between February 2013 and November 2014 among the Northern Sotho of Dikgale community in Capricorn District of the Limpopo Province, South Africa. Dikgale community is located within Polokwane Local Municipality approximately 40 km from Polokwane City, and 15 km from University of Limpopo in Mankweng Township. The community covers an area of 71 square km and is 6 km long and 10.8 km wide. It is situated between 23.46Q-23.48Q south latitude and 29.42Q-29.47Q east longitude. It lies at an average altitude of 1400 above mean sea level. The study area is on the Highveld Plateau, which is bounded in the south and south-east by the Strydpoort Mountains and in the east and north-east by the Wolkberge. Dikgale area lies in a semi-arid climate type with an annual rainfall of approximately 505 mm. It has a daily average summer temperature of between 16QC and 27QC with the winter average temperature between 5QC and 19QC. Summer rainfall occurs between October and April, followed by a dry winter season (Polokwane Local Municipality Integrated Development Plan [IDP] 2013/2014).

The community has more than 50 years of existence. It has a population of about 45083 with a population density of 116 per square km. The site is peri-urban and the main ethnic group is *Pedi*. The primary language spoken by community members is *Sepedi*. Dwelling units consist of a mixture of traditional mud huts and conventional brick houses. A few households have water taps in their yards, but most fetch water from taps situated at strategic points in the community. Most households have pit latrines in their yards, but there is no organised waste disposal (Statistics South Africa 2011). Infrastructure is poor, but the main roads are tarred. Remarkable achievements include building of schools and clinic, and construction of roads linking the community with major resource centres such as the university, hospital and neighbouring communities (Kanjala et al. 2010). Although the economy and sources of income have been diversified and expanded, many families still rely on the indigenous subsistence economy for their livelihood, and depend on wild plant material for fodder and fuel. Most community members still value cultural traditions such as traditional healing, livestock raising, ploughing the fields and ritual offering which are highly reliant on the use of wild plant biodiversity

(Rankoana 2000). The rain-fed crops are mostly planted in the home-gardens than in the past when they were planted in the ploughing fields due to erratic rainfall patterns. Cattle, goats and sheep are raised by fewer households. Livestock-raising is no longer common practice because expensive stock feed is sourced from the local white farms due to the scarcity of natural feed from the natural wild (IDP 2013/2014).

SAMPLING SIZE AND COMPOSITION

Hundred participants (39 males and 61 females) aged 45 years and above were purposely selected from Dikgale community. This group of community members was selected on the basis of their knowledge of environmental conditions necessary for their livelihood patterns. This selection criterion is supported by the United Framework Convention on Climate Change (UNFCCC 2007) that traditional consumption systems are dependable upon the natural environment and have contributed to increased understanding of changing environmental conditions.

DATA COLLECTION AND ANALYSIS

Focus group discussions were conducted with ten groups of ten participants each. This methodological approach was used to get collective perceptions on climate change and whether it has negatively implicated the availability and consumption of indigenous vegetables in the community. Discussions were conducted in *Sepedi*. Investigation of the availability and consumption of indigenous vegetables was done by asking the participants to provide the names of indigenous vegetables they collect and prepare to relish porridge. This question was followed by questions about the vegetable sources, the season of collection and their status of availability and consumption. Assessment of the impact of climate change on the availability and consumption of the vegetables was done by asking questions on the threats of changing temperature and rainfall patterns on the availability of the vegetables. Content analysis was used to analyse perceptions on climate change and its impact on the availability and consumption of indigenous vegetables.

TRUSTWORTHINESS AND ETHICAL CONSIDERATION

Following data collection process, a community consultation meeting was organized to have all the participants together to review the collected data. The objective of the gathering was to identify and clarify discrepancies, contradictions and gaps to validate the results. Quick reviews of data were done with the participants to provide corrections to inconsistencies, contradictions and data gaps. Ethical approval was obtained from the University of Limpopo. The local authorities allowed the researcher to conduct the interviews in the community. The participants consented to participate in the study by signing the consent form and their names and identities remained anonymous.

RESULTS AND DISCUSSION

INDIGENOUS VEGETABLES OF DIKGALE COMMUNITY

AVAILABLE VEGETABLES

All the participants identified six indigenous vegetables they collect and prepare to relish porridge. These fewer vegetables are still collected as sources of vegetable side-dishes whenever they are available. The vegetables grow as weeds in and around the home gardens, in the wild and ploughing fields. Vegetable gathering is a specific culturally and economically accepted type of work. The work is not done in a haphazard way as only the desired portions, namely tender leaves, are collected. Indigenous vegetables are the largest group of plant species consumed in Bulgaria with above-ground parts, young leaves, shoots and stems gathered and used as vegetables (Nedelcheva 2013). Their use is also widespread in South African rural communities, with over 90% of households using them in a single community (Shackleton 2002).

SEASONAL AVAILABILITY

The participants reported that they collect the vegetables seasonally between the months of October and March or as the vegetables are available in the home gardens, in the wild and ploughing fields.

PRESERVATION STATUS

The participants identified preservation methods used to ensure constant supply of the vegetables throughout the year. Participants agreed that provision of the resource is seasonal, but the women are able to preserve the vegetables for consumption throughout the year. The method of cooking the vegetables is by boiling the fresh leaves for about an hour. Preservation of the cooked vegetables involves kneading them thoroughly by hand and shaping it into small lumps (*dikwatan*). The lumps are dried on a piece of corrugated iron and stored in containers. The vegetables that could be preserved are *Amaranthus thunbergii* (theepe), *Cleome monophylla* (lerothe) and *tshehlo Tribulus terrestris* (tshehlo). The uncooked materials are dehydrated and stored for consumption at a later stage. The dehydration process involves the spreading of fresh leaves on the earth floor of *lapa* (the hut enclosure) to dry off. The dried materials are stored in a container for future consumption as *morogo-wa-tshwahla* (a potherb prepared from the dehydrated leaves). Varieties are *tshwah/a-ya-theepe*, *tshwah/a-ya leroto* and *tshwah/a-ya tshehlo*. The participants attested that a vegetable prepared from the dehydrated leaves has the same taste as the one prepared from the fresh leaves. Maanda and Bhat (2010) confirm that indigenous vegetables can be dried and stored for use when the species are not available.

The indigenous vegetables consumed by participants are the following:

Table 1. Indigenous vegetable of Dikgale community

Botanical name	Family	Local name	Preservation status
<i>Amaranthus thunbergii</i>	Amaranthaceae	<i>Theepe</i>	The dish is prepared from fresh leaves. The fresh leaves can be dehydrated, and the cooked product dried and stored for future use.
<i>Amaranthus spinosus.</i>	Amaranthaceae	<i>Letelele</i>	The dish is prepared from fresh leaves. Preservation is poor because the leaves and produce have slimy texture.
<i>Cleome monophylla</i>	Capparidaceae	<i>Lerotho</i>	The vegetable is prepared from fresh leaves and eaten fresh or dried. Fresh leaves are dehydrated and the cooked products are dried for future use.
<i>Cucumis etticenus</i>	Cucurbitaceae	<i>Monyaku</i>	The product is prepared from fresh leaves. Preservation is poor because of the rough texture.
<i>Tribulus terrestris</i>	Zygophyllaceae	<i>Tshehlo</i>	The vegetable is prepared from fresh leaves. The vegetable is not relished by many people because of its bitter taste. Fresh leaves are dehydrated for future use.
<i>Vernonia fastigata</i>	Asteraceae	<i>Lehlanye</i>	The product is prepared from fresh leaves. The relish is not liked by many people because of its bitter taste. Fresh leaves are dehydrated for future use.

OBSERVED IMPACT OF CLIMATE CHANGE ON THE AVAILABILITY AND CONSUMPTION OF INDIGENOUS VEGETABLES

Observations of change in climatic conditions were reported among the participants. Two indications of climate change namely; unpredictable rainfall and increased temperature patterns were reported. To these observations Tschaker (2007b) says that communities that rely on natural resources for their livelihood quickly discern climatic anomalies and their effects on their livelihood. Increased temperature and unpredictable rainfall were reported to have negatively impacted the availability and consumption of indigenous vegetables. This finding is corroborated by Bhusal (2009), Davis and Ali (2014) that indicators of climate change are increases in temperature patterns, low rainfall and low crop yields observed by local communities.

EFFECTS OF CHANGING RAINFALL PATTERNS

The participants reported that while the first rainfall was expected between September and November, of late the first rain falls between December and January. Unusual precipitation is persistently experienced between February and June. Participants identified factors associated with changing rainfall patterns.

These factors are evidence of the scarcity of indigenous vegetable and a decline in their limited consumption. Of the participants, 85% stated the following:

'Collection of smaller quantities of indigenous vegetables sources in the home gardens and fields; late rainfall; drying-off of immature vegetables; Withering of the vegetables before they could bear seeds; overharvesting of scarcely encountered vegetables in the home gardens and ploughing fields; collection of vegetables in other people's home gardens and fields'

The most commonly identified implications of erratic rainfall patterns were the scarcity of the vegetables. Ninety percent of participants mentioned that the vegetables are rarely encountered in the home gardens, fields and the wild. It was common understanding that if it does not rain, the vegetables will not grow. On this issue Van Jaarsveld and Chown (2001) demonstrate that centres of plant endemism in South Africa are likely to experience novel climate conditions and will be susceptible to community transformation. The participants observed that availability of the vegetables in Dikgale community is dependable upon favourable rainfall patterns. Ninety five percent participants mentioned that the vegetables are available immediately after the first rain, and will last until the harvesting of crops in the fields in April and June, but due to observable scarcity of rain the vegetables are becoming scarce and less consumed. The remarkable impacts of climate hazards namely; drought, depletion of biodiversity, soil erosion and decreased agricultural productivity (Maponya & Mpandeli 2012) may lead to the scarcity and extinction of edible plant materials in the wild.

EFFECTS OF CHANGING TEMPERATURE PATTERNS

The participants reported remarkable increase in temperature patterns. Eighty three percent of participants stated that recently summer is excessively hot and winter is warmer. Furthermore observations were increased temperature patterns coupled with unpredictable rainfall which are responsible for prolonged drought and excessive heat. Participants showed that unpredictable rainfall patterns result in responsible for increased temperature patterns and vice versa. Jarraud (2011) validates the participants' observations of increasing temperatures and erratic rainfall patterns by showing that from 2001 to 2010, global temperatures have averaged 0.46°C above the 1961-1990 average temperature, and are the highest ever recorded for a ten-year period since the beginning of instrumental climate records. All the participants identified factors associated with increased temperatures. These factors provide evidence of the negative impacts of excessive heat on the availability and consumption of indigenous vegetables. Ninety three participants identified the following:

'The vegetable are destroyed by heat; Scarcity of the species; Vegetables exposed to wind and may easily wither; Shallow and barren soil which may lead to poor quality of the vegetables to be collected; Poor seed formation and dispersal for re-grow in the next season; Inconsistent availability because in some years there are no vegetables collected in the wild as vegetables; The vegetables are available in late December to early January the following year'.

The participants showed that consumption of indigenous vegetables is limited because the vegetables are scarce. Fewer vegetables that are encountered in the home gardens are sustained by household practices such as waste water use and propagation of species such as *Cleome monophylla*, *Cucumis etticenus* and *Amaranthus thunbergii*. This observation is corroborated by Adebooye & Opabode (2004) that a decline in the consumption of indigenous vegetables can be attributed to a decrease in their availability. A contention about the availability of indigenous vegetables is provided by Nesamvuni (2000), Modi et al. (2006) & Van Vuuren (2006) that the vegetables grow well during drought periods and in areas with low or unreliable rainfall, survive in poor soils, require less inputs and resources during production and are often available.

CONCLUSIONS

The members of Dikgale community are aware of changing climatic conditions in the form of increased temperature and scarce rainfall. The effects of increased temperature and scarcity of rainfall have a negative impact on the availability of indigenous vegetables. Consumption of these vegetables is dependent on the species availability. Increased heat destroys the vegetables. Unpredictable rainfall patterns is a major threat to the availability of the vegetables. However, in some years smaller quantities of the vegetables are collected while in other years the vegetables would not be available at all. The smaller quantities of the vegetables collected, are prepared and stored for future use. The results of the study could be used to inform policy on mitigation and adaptation measures to cope with the impacts of climate hazards on the availability of indigenous vegetables to sustain the livelihoods of rural community members.

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