

# Weather Forecasting Using Local Traditional Knowledge (LTK) in the Midst of Climate Change in Domboshawa, Zimbabwe

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## 1 Background

Zimbabwe's economy is agriculture-based, and agriculture provides employment for 70% of the population (Chenje et al. 1998). Because agriculture is heavily dependent on weather, and on rainfall and temperature particular, in areas where rainfall is erratic and inadequate, agricultural productivity becomes highly correlated with weather. Zimbabwe is becoming more vulnerable to climatic changes and local climatologists predict various sectoral impacts that will affect the environment, agriculture and food security, health, water resources, economic activities, human migration and physical infrastructure. Not all farmers, particularly those in remote areas, have access to radios and other media that communicate weather forecasts, nor do they have the capacity to interpret such forecasts. At this juncture, Agritex officers should fill the gap, but the situation on the ground defies this logic. Agritex officers are crippled by the department's lack of resources, a consequence of the economic challenges that Zimbabwe has experienced in the past decade (1999 to present). The importance of indigenous, traditional, and local knowledge in agricultural sustainability has been much discussed, yet on the ground it is only applied sparingly. "Indigenous knowledge" goes by many names: traditional knowledge, ancestral knowledge, local knowledge, and traditional ecological knowledge (Dewalt 1994). Although each term carries its own connotations, there is substantial overlap. The International Council for Science defines traditional knowledge as "a cumulative body of knowledge, practices and representations maintained and developed by peoples with long histories of interaction with their natural environment" (ICSU 2002). Huntington asserts that traditional ecological knowledge is "knowledge or insights gained through extensive observation of a particular ecosystem" (2000,

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1270). Viswanathan refers to it as “a common body of knowledge about trees, fodder, forest products, seeds, medicine, [and] building” (2005, 89). Local communities are keepers of valuable knowledge that can help in their development and should therefore be empowered to blend traditional knowledge systems with modern technology as a step toward launching green revolution.

## **2 LTK in Climate Variability and Change in Agriculture as Postcolonial Theory**

The post-colonial state as a successor to the colonial state was basically a political construction. The institutional framework that has informed the post-colonial state has its foundation in a colonial state whose interests cannot be said to be the same as those of the post-colonial state (Mapara 2009). For example, many African leaders easily retreat into the argument that Africa’s lack of development is a consequence of colonialism (Ashcroft et al. 1995). However, evidence on the ground shows that the post-colonial African state has failed to objectively determine the type of institutional framework that is needed to inform the state’s actions, the role of non-state actors, and choices regarding the correct circumstances for state intervention. Post-colonial theory posits that from its beginning, colonialism on the African continent despised everything that was traditional or indigenous (ibid). African traditional religion was abandoned and this interfered with African social, economic and political systems, under the mistaken belief that everything traditional was primitive. An attempt was made by colonialists to dislodge indigenous institutions and pave the way for the establishment and perpetuation of western supremacy. This prejudicial stance was influenced by the ‘centre-periphery’ hypothesis, whose purpose was to deliberately dislocate traditional African culture (the periphery) and replace it with western culture and civilization (the centre). However, some vital traditions still exist; little did the colonialists realise that African beliefs and practices were grounded in hard empirical evidence based on past African experiences, including, for example, the ability to monitor weather and climate.

Local Traditional Knowledge (LTK) is more than just a display of the knowledge and belief systems of the previously colonized; it is one of the responses to the myth of Western hegemony and superiority (Tatira 2000; Mararike 1999). Some of this knowledge was labelled as unconventional and as not based on empirical evidence. However, LTK is one of the ways in which the formerly colonised are reclaiming the self-esteem and humanity that they had been deprived of by colonialism. It is also an effort to show the world that they are not always on the periphery but rather are equal to their former colonisers in some respects (UNEP 2000). By using examples of the achievements of the formerly colonised, the once-colonised are asserting their visibility in history, education, architecture, philosophy, language and science. In a way, this is to show that that the formerly

colonised have either been misunderstood or were deliberately ignored. LTK as postcolonial theory also challenges the colonial label of the ‘other,’ as LTK has its own past glories and achievements, including LTK repositories. LTK systems are forms of knowledge that are characterised by integrated systems of cognition, belief and practice that are embedded in proverbs, myths and some religious rituals. Those who understand the languages that carry these practices can best appreciate them.

Indigenous knowledge is the basis for local-level decision-making in many rural communities (Mararike 1999). It has value not only for the culture in which it evolves but also for scientists and planners striving to improve conditions in rural localities. Incorporating indigenous knowledge into climate-change policies can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable. In this chapter, we will use “indigenous knowledge” or “local traditional knowledge” to refer to the understanding of the local environment developed by Zimbabwean communities over the last several millennia; this includes practices, techniques, technologies and spiritual knowledge that encompasses every aspect of human existence (Mapara 2009). It is worth noting that communities in Zimbabwe know that climate is closely linked to the sustainability of their livelihoods. Patterns of weather, how and when local natural disasters occur, when they are likely to recur, and how to plan to cope with their impacts on the natural environment, as well as on livelihoods and lives, have all been noted down. In Africa, many communities have developed techniques and strategies for forecasting and managing climate variability, including coping mechanisms to respond to both the normal and harsh conditions of their local environments. This forecasting depends on observation of the natural environment, including flora, fauna and stars.

### **3 Bridging the Gap Between Traditional Knowledge and Climate Science**

Western science is a systematic and methodological approach to answering questions; science is equated with knowledge that promotes the solution of problems. Western science is based on the principles of repeatability and predictability. It is unfortunate that Western science tends to label LTK as anecdotal, non-quantitative, without method, and unscientific, though LTK offers basic knowledge that is available to all. As opposed to LTK, Western climate science uses knowledge of atmospheric physics to predict the most probable future weather/climate scenarios. Although the two knowledge bases (LTK and Western climate science) are very different, both try to solve the same problems. Thus, the fusion of the two, or using the knowledge base that is readily understood by local people, will help the community adapt to climate change. Table 1 shows the main differences between LTK and western science.

**Table 1** Comparison of scientific knowledge and local knowledge

Factor	Science	Indigenous knowledge
How approached	Compartmental	Holistic
How communicated	Written, easy to translate and communicate. Somewhat standardized terms	Oral, in local language, and needs to be interpreted
How taught	Lectures, theories, and observations useful for scientific interpretation and modelling	Observation, experience Observations are of importance to daily life
How explained	Theory, “value free”	Spiritual, social values
Repeatability	Repeatable measurements Can use same monitoring equipment in different places	Possibly poor repeatability Cannot expect similar perceptions and experiences for same observation
Precision	More precise, errors more objective and amendable Results from repeated measurements	Perceptive, individual, errors difficult to evaluate Every individual has different perceptions, possible bias
Spatial coverage	Time and space sparse, interrupted time-series Depends on monitoring network	Dense in space and time, long term observations Every individual is an observer
Tool	Designed instruments, limited, focused, recorded	Many undefined instruments, unfocussed observation, mostly unrecorded Different sensors, word of mouth, passing of information through generations
Scale	Large scale, general, conceptual	Smaller scale, specific, practical

Source Adapted and modified from Dewalt (1994)

LTK is a key source of information and insight in agroforestry, traditional medicine, biodiversity conservation, customary resource management, impact assessment, and natural disaster preparedness and response (Makwara 2013). Indigenous observations and interpretations of meteorological phenomena are at a finer scale, have considerable temporal depth and highlight elements that may be marginal or even new to scientists. They focus on elements of significance for local livelihoods, security, and well being and are thus essential for adaptation. Strategies such as engaging in multiple livelihood activities and maintaining a diversity of flora and fauna varieties provide a low-risk buffer in uncertain weather environments. Traditional systems of power and social networks develop the capacity to collectively control variety and distribute resources, while dissipating shocks and reinforcing new capacities.

## 4 Why Indigenous Knowledge Is Important for Climate Change Adaptation

Previous studies have demonstrated that rural communities respond actively to the challenges posed by climatic variability and change, thus showing that these communities are not inactive. For example, in Tanzania, farmers faced with drought switch crops, expand cultivation and seek alternative employment (Berman et al. 2012). Local communities are dependent on *their* knowledge, *their* special relationship with the environment, and *their* ways of organizing themselves and *their* values. In the southern Arctic, Inuit people have made adjustments in hunting patterns as the climate has warmed (Berkes and Jolly 2001). Most existing studies of climate change and variability are anecdotal; few scholars have offered an overarching theoretical framework for understanding how traditional knowledge supports adaptation. LTK can be used to forecast the total rainfall for an agricultural season and inform the farmers' cropping activities. This is especially common in cases where conventional weather information is not easily accessed or understood by the recipients, as in Zimbabwe. Nyong et al. (2007), in their study of LTK in the Sahel, get closest, suggesting that traditional knowledge is important for five reasons:

- it adds cultural context;
- it is often “appropriate and sophisticated”;
- it increases community buy-in;
- it promotes “equity, efficiency, and the environment”;
- it increases “communication and understanding” (Dewalt 1994)

LTK is useful in two particular ways, as indigenous communities can help scientists understand both current and expected climate change impacts. Indigenous knowledge in the form of weather forecasting strategies, knowledge of crop varieties, agricultural practices, water storage methods, building techniques, and more can help communities preserve their quality of life even in the face of climate change. Western scientists can benefit from indigenous observations of weather and environmental change. LTK is equitable and environmentally friendly, as suggested by Nyong. Unfortunately, this creates a tendency to view all indigenous peoples as living in harmony with one another and with nature. This is, however, too simplistic because any given community is not innately more noble or even more sustainable than another given community. Suffice it to say that traditional communities know things about their environment that outsiders do not; such knowledge is, in fact, “appropriate and sophisticated” and can help in the development of more valuable adaptation programs.

Both scientific knowledge and LTK have limitations. Historical and contemporary evidence show that indigenous peoples have also committed environmental ‘sins’ through over-grazing, over-hunting, or over-cultivation of the land. Contrary to the popular viewpoint that whatever indigenous people do is naturally in

harmony with the environment, LTK is not as always ‘good,’ ‘right’, or ‘sustainable.’ For example, because of globalisation and migration, in areas where local people are recent migrants from a quite different ecological zone, they may not have much understanding of their new environment. Economic and social forces may contribute to the erosion of LTK due to integration with society at large, which will result in the breakdown of social structures, beliefs, mores, norms, and the educational and religious systems that generate indigenous knowledge and practices. This results in the ‘homogenization’ of the world’s cultures and the subsequent alteration of indigenous beliefs, values, customs, know-how and practices, thus resulting in an incomplete knowledge base (Grenier 1998). Socio-ecological systems are undergoing severe environmental degradation, and LTK that was once well adapted and effective for securing a livelihood in a particular environment is becoming unsuitable (Thrupp 1998). When change is rapid or drastic, the knowledge associated with LTK may be rendered inappropriate and even destructive in the altered conditions (Grenier 1998). Sometimes, the knowledge that local people rely on is incorrect or even harmful (Thrupp 1998). Practices based on mistaken beliefs, flawed experimentation, or incorrect information can be risky and may even obstruct improvements to the well being of indigenous people (Thrupp 1998). Moreover, LTK is mainly contained in the mind of its beholders, and when they die, their knowledge dies as well. Without documentation of this knowledge, the surviving generations can only misquote and misinterpret it. LTK has been ignored in the past and, in some cases, has actually been lost. The skills of recognizing, gathering, and building up LTK into formats that are usable today are essential to ensure the sustainability of this knowledge. Our focus on marrying local knowledge with modern science to promote sustainable agriculture will be futile without documentation (Dewalt 1994). Over-reliance on western science, which is not sufficiently location-specific, seems to be one of the most important challenges threatening the sustainability and viability of indigenous knowledge. In a given area and in different villages, the knowledge bases of LTK may be different. Thus, there is a need to harmonise LTK in districts and the country at large.

## 5 Research Aim and Scope

Climate variability and change is increasingly becoming a serious challenge to ecology, health, human well being, livelihoods, and future sustainable development for people in emerging economies, especially in Africa. Climate deviations that are too far from the norm can be extremely disruptive to communities. Traditional weather forecasting has been used since time immemorial to identify matters affecting the vulnerability of ecosystems and communities. Credible environmental information has the potential to empower people at all levels to influence decision-making (Chenje et al. 1998; Makwara 2013). This information can thus be helpful to government departments, Non-Governmental Organisations (NGOs) and

ordinary people, helping them to better appreciate the environments in which they live and possibly adjust their plans to improve their livelihoods. Use of indigenous knowledge of weather forecasting is a strategic mechanism to support sustainable development because it may inform people about past and current weather conditions (Makwara 2013). Experiences of scientific weather forecasting by the Meteorological Services Department (MSD) in Zimbabwe have demonstrated that relying on western scientific methods does not always yield accurate weather estimates (MSD 2012). IKS can therefore be harnessed to complement scientific methods of weather forecasting. The impacts of climate variability and change are multifaceted and may be accompanied by multiple additional stressors such as poverty and land degradation. Hence, there is a need for multifaceted responses such as the use of indigenous knowledge. This section describes how farmers in Domboshawa in particular predict rainfall using local environmental indicators and astronomical factors. Even without the modern system of dividing time into months, seasons and years, humans have been able to appreciate diurnal and seasonal changes in the environment. This knowledge can be used in determining the timing of important farming activities and in predicting disasters. Being able to predict weather is an important ability of humanity. This research aimed to:

- (1) Identify, document and analyse LTK indicators used in drought forecasting in Domboshawa;
- (2) Assess the possibility of providing a localised drought early warning system based on a traditional calendar of drought indicators and;
- (3) Assess the possibility of integrating LTK indicators with meteorological forecasting indicators to improve seasonal forecasts at the local level.

## ***5.1 Materials and Methods***

Simple random sampling was used to select respondents from five wards in Domboshawa, producing a sample size of fifty (10 from each ward). Purposive sampling was used to select interviewees, including the Chief, Headmen of Agritex, and EMA Officials. Purposive sampling was also used to select 20 farmers who responded to questionnaires. This sampling technique was chosen because it helped to select only those informants judged to be knowledgeable about the data sought (Kumar 2010). Ten focus group discussions (FGDs) were conducted in the five wards of Domboshawa. Two FGDs were conducted per ward and these comprised mainly farmers because the majority of the households are farmers. Various data collection methods (key informant interviews which were based on situational and behavioural responses, structured open ended questionnaires and field observations) were employed for triangulation purposes, which served as a tool for cross-checking the authenticity and validity of the various data sets generated through FGDs. Emic knowledge and interpretations exist within a culture and are influenced

by local customs, meanings and beliefs though etic (scientist-oriented) approaches where used as well (Albuquerque et al. 2014). The two complement each other. The research was conducted within a period of 6 months i.e. from October, 2013 to March, 2014 mainly because this is the main rainfall period in Zimbabwe. Data were analysed using MS Excel and SPSS and coded and categorised into themes and sub-themes. Afterwards, data were analysed through thematic content analysis. Descriptive statistics, frequencies and percentages were also used in data analysis.

## 6 Context of Research

The research was carried out in Domboshawa (its geographical coordinates are 17° 36' 18" South, 31° 8' 24" East), which comprises approximately 40,000 households with an average household size of 5 people and with more than 75% of these people relying on farming for their livelihoods (Mashonaland East Provincial Census Report 2012). There are 5 wards in Domboshawa. The population has increased due to natural increase and net migration. Domboshawa has a land area of 35.312 hectares and is situated in natural farming regions 2 and 3 on the Highveld of Zimbabwe at 1200 m.a.s.l. The average rainfall ranges from 800 to 1000 mm per annum (Unganai 1996). During drought years, however, the rainfall tends to decrease, e.g., during the 1991/92 drought the rainfall was 405 mm. Rainfall is seasonal, with approximately 90% falling from October to March (Vincent and Thomas 1960). Temperatures in Domboshawa are generally warm in the summer months, ranging from 22 to 30 °C (MSD 2012). However, winters can be quite cold, with temperatures dropping down to freezing levels. Because the majority of people make their livelihoods from horticultural crops, they need adequate protection in winter, especially in dry areas, so that their crops are not damaged by frost. The soils of Domboshawa are generally coarse-grained sands/sandy loams, which are naturally deprived of principal plant nutrients (the paraferralitic group of soils). Paraferralitic soils absorb and lose water easily (Surveyor General 2014). The topography of the area is quite varied, with some undulating areas, but generally the area is rugged and rocky (hence its neglect by early colonial settlers) (GRDC 1996). The Ngomakurira Hills (Mountain of Drums) and the Domboshawa Hill (The Red Rock) are some of the area's spectacular topographic features that attract tourists. Vegetation is mainly Miombo woodland dominated by muzhanje (*Uapaca kirkiana*), muhacha (*Parinali curatefolia*), munhondo (*Julbennadia globifera*), musasa (*Brachystegia spiciformis*), mupfuti (*Brachystegia boehmii*), mususu (*Terminalia sericia*) and muunze (*Brachystegia globifera*). The Miombo vegetation is declining due to uncontrolled cutting of trees by urban, peri-urban and communal residents. The few remaining woodlands form part of the grazing lands and are restricted to rugged terrain, which cannot be used for crop production. Varying climate and vegetation characteristics depicted in each Ward were captured. Households in each ward were randomly selected. The questionnaire was pilot



tested before it was used for the larger sample. Households' varied perspectives on LTK and on drought forecasting dry spells and droughts were obtained with the use of this structured questionnaire. Aspects such as demographic features of the population and drought history; response to droughts; drought adaptation strategies; local traditional indicators as well as respondents' perceptions and knowledge of meteorological drought forecasting methods were also included (Fig. 1).

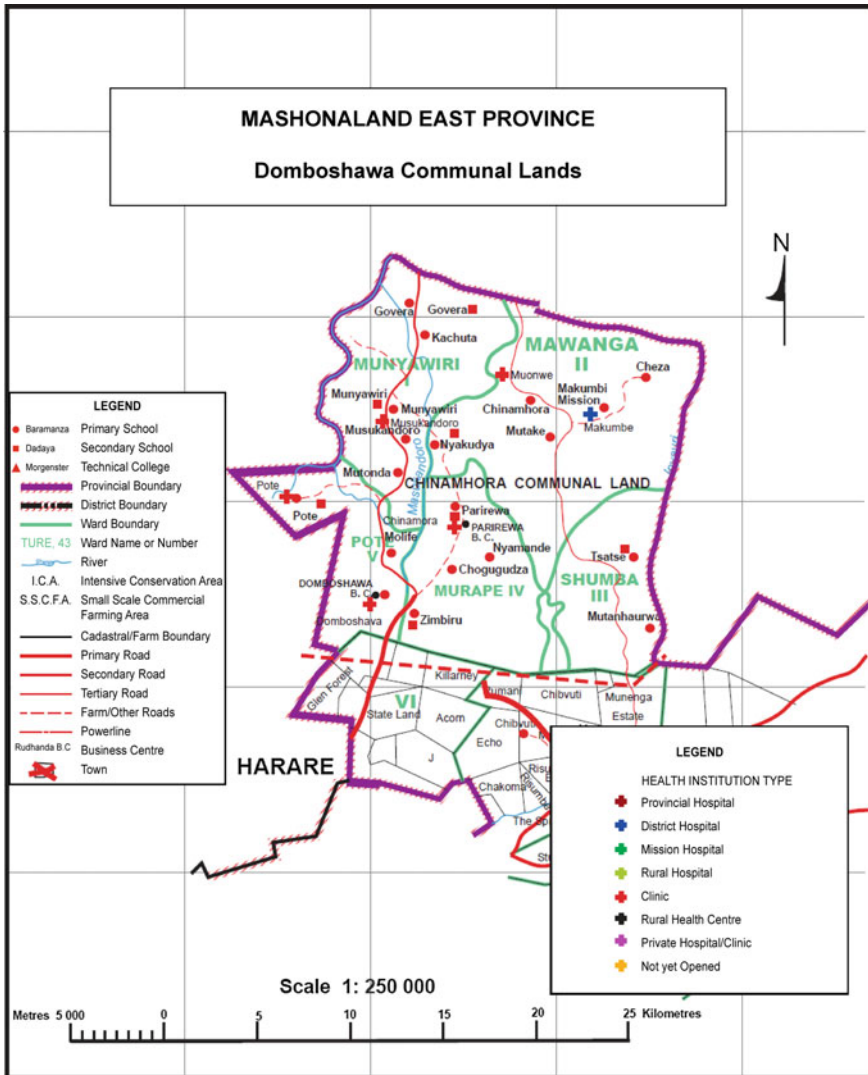


Fig. 1 Domboshawa communal lands. Source Surveyor General: June 2014

## 7 Discussion

### 7.1 *Climate Change and Indigenous Communities in Domboshawa*

The Domboshawa study shows that weather patterns are influenced by the wind, the stars, and animal and plant behaviour, as well as by the availability of wild fruit, cloud formation, birds, insects and wind direction prior to the rainy season. In spite of complicated 21st century methods of determining weather patterns, this article examines the importance of indigenous knowledge in determining and understanding weather patterns and the effect of weather patterns on farmers. Samples of some LTK forecasting techniques used in Domboshawa are given below (Tables 2 and 3).

### 7.2 *Convergence Between Indigenous and Scientific Approaches*

In Domboshawa there was convergence between both western science and LTK regarding what was evident on the ground. All respondents noted that water was becoming increasingly scarce and that there was an increase in the outbreak of diseases during floods. As a result of these environmental changes, there has been an increase in migration, although there is positive net migration due to the proximity of Domboshawa to Harare.

### 7.3 *Typologies of Shona Indigenous Weather Forecasting*

One of the indigenous rainfall prediction indicators that the farmers in Domboshawa use is the density of spider webs in their area. Many spider webs

**Table 2** Domboshawa farmers’ indigenous views on climate variability and change

<ul style="list-style-type: none"> <li>• They no longer grow the crops they used to grow in the past</li> <li>• Seasonal fruits no longer grow due to the effect of climate change, crop failures</li> <li>• Relocation due to rainfall</li> <li>• Dry and hot summers instead of wet and cold summers</li> <li>• Temperature fluctuation</li> <li>• Rainfall changes</li> <li>• Reduced water levels</li> </ul>
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Source Field Data (May 2014)

**Table 3** Scientific views of climate change

• Changes in temperatures (temperatures are increasing)
• Variability of rainfall
• Reduced water levels
• Ecosystem distressed and some species vanishing
• Change in farming practices
• Yield is dropping drastically
• Seasonal variations

Source Field Data (May 2014)

signify a very wet season, and the circular halo around the moon (known as *dziva* in the local Shona) is used to predict the wetness of that particular period of the season. Additional indicators include animal and plant behaviour, as well as wild fruit availability and wind direction prior to the rainy season. Though these indicators are local, they definitely show some level of dynamism and mixing of western science and LTK.

### 7.3.1 Derivation of Weather Forecasts from Bird Indicators

This refers to a bird whose behaviour is studied to derive a weather forecast. For bird indicators, please refer to Table 4.

**Table 4** LTK interpretations of bird indicators

Behavioural sign	Forecast
<i>Ducks</i>	
1. Flapping wings frequently	Rains expected soon
2. Moving about restlessly	Dry spell expected
<i>Swallows</i>	
1. Flying haphazardly in large numbers	Imminent rains
2. Few and flying at great height	Dry spell expected
<i>Black crow</i>	
Crowing very early in the morning	A very hot afternoon expected
<i>Migratory stock</i>	
Presence in large numbers	Sign of good, warm rain season
<i>Tinker bird</i>	
Singing	Hot days expected

Source Field Data (May 2014)

### 7.3.2 Derivation of Weather Forecasts from Creatures or Animals

This refers to either a creature or animal whose behaviour is observed with the intention of generating a weather forecast. One of the indigenous rainfall prediction indicators that the farmers in Domboshawa use is the density of spider webs in their locality, with the presence of many spider webs being an indication of a very wet season. Hasty spiders struggling to get indoors or into hiding places are an indication of the beginning of Munhuruka rains. (Common rain names in Zimbabwe include *gukurahundi*, which washes away chaff; *mvumiramutondo*, which facilitates the blooming of trees; and *munhuruka*, which signals the beginning of the rainy and cropping season). All the respondents said they are quite aware of these rains and their significance. Usually land is prepared after munhuruka rains as argued by 65% of the respondents. For other animal indicators, please refer to Table 5.

### 7.3.3 Derivation of Weather Forecasts from Vegetation

This refers to a condition or to the prevailing characteristics of specific vegetation, which are used to derive a weather forecast. Wild fruits and abundance of fruits

**Table 5** LTK interpretations from creatures or animals

Behavioural sign	Forecast
<i>Frogs</i>	
1. Croaking profusely	Signifies rains
2. Producing sharp shrills	Drizzle expected
3. Bull frog croaking with high tone	Rains the next day
<i>Termites</i>	
Stockpiling grass	Guti/rainy weather
<i>Ants</i>	
Appearing in large numbers	Sign of heavy rains
<i>Cattle</i>	
1. Sniffing the air with heads raised up	Expect immediate rains
2. Bellowing on dry riverbeds	Rains expected soon
<i>Fish</i>	
Jumping into the air frequently	Rains are about to come
<i>Goats</i>	
Bearing lots of kids	Sign of hot and wet season
<i>Grasshoppers</i>	
Appearing in larger numbers	Rains expected soon
<i>Armyworm</i>	
Large numbers	A dry spell expected

Source Field Data (May 2014)

**Table 6** Derivation of weather forecasts from vegetation

Behavioral sign	Forecast
<i>Wild loquart (Uapaca kirkiana)</i>	
1. Abundant fruits	Good rainfall expected
2. Abundant fruits	Chances of drought
<i>Fig tree (Fiscus carica)</i>	
1. Plenty of fruits	A good rain season
2. Shooting	Rains are near
3. Shading leaves	Rains close by
<i>Aloe Tree</i>	
1. Blooming	Rains expected in 48 h
2. Producing green or red flowers	Signifies a drought
<i>Julbernardia globiflora (Munhondo)</i>	
1. Lots of spring foliage	Good rainfall season expected
2. Blooming in August	Early rains
3. Late blooming	Drought expected
<i>Parinari curatellifolia (Hacha)</i>	
1. Abundant fruits	A good rain season
2. Abundant fruits	Drought expected

Source Field Data (May 2014)

such as *parinari curatellifolia* (hacha), *uapaca kirkiana* (mazhanje) and *nhunguru* indicates a good rainfall season. Sixty two percent of the respondents argue that they used vegetation to derive weather forecasts. For other vegetation indicators, refer to Table 6.

### 7.3.4 Terrestrial Objects

One of the celestial bodies that the Shona of Domboshawa have used to predict rainfall conditions is the sun. There are many associations with the sun in terms of rainfall and temperature patterns (Shoko 2012). When the rainy season is about to begin, the sun does not heat people's heads directly; in such cases people notice that the sun is coated by *gore* (fog or mist). Shona people believe that when the *gore* is small then rainfall will be minimal as 64% of the respondents said When the *gore* is large there will be more rainfall. During the rainy season, when the day is hot, people expect rains either that very day or within two days. This inference is made in light of the day's excess of heat. Conversely, when it is cold and rainy people regard it as a sign of a lack of rain. The Shona people also use the moon to forecast weather patterns. The moon is used to predict the imminence and intensity of the rainy season. There is more rainfall when the moon does not appear for a long time

**Table 7** LTK interpretations of terrestrial objects

<i>Sun</i>	
1. Presence of halo around the sun	Heavy rains are expected
2. Very hot in October and September	Rains are expected soon
3. The occurrence of an eclipse enhances chances of a good rainfall season	Enhanced chances of good rainfall
<i>Moon</i>	
1. A moon with tilted orientation	Drought expected
2. A moon with normal orientation	Rains expected soon
3. Full moon (Jenaguru)	Rains unlikely
4. Halo around the moon	Abundant rains expected
5. Appearance of 1st quarter and last quarter	Good chances of rain exist
6. No moon (Mhindo)	Chances of rain are enhanced
<i>Stars</i>	
1. Few stars appearing	Rains about to come
2. Star for good rainfall (Maguta) bigger than star for drought (manzara)	A good rainfall season expected and vice versa
3. Drought star (Manzara) appearing with star for good rainfall (Maguta) missing	Drought is expected and vice versa
4. Big Drought Star (Manzara) on the eastern side	Drought expected
5. Big Star for good rainfall (Maguta) on the western side	A good rainfall season expected
6. Plenty of falling stars	Drought expected

Source Field Data (May 2014)

during the night. When the moon appears with a ring around it, it is a sign that the rainy period is impending. The Shona people believe that the size of the ring coating the moon determines the amount of rain to be enjoyed that season. The bigger the ring, the more rainfall that season, and likewise the reverse is true. They also look at the circular halo around the moon; known as *dziva*, to predict the wetness of that particular period of the season. All in all 72% of the respondents said that they use terrestrial objects to predict the weather (please refer to Table 7).

### 7.3.5 Wind

Although these indicators can be said to be indigenous, they certainly show some level of dynamism and integration with western science, which has also tapped into these indicators and uses wind direction to predict rainfall patterns. More than 50% of the respondents indicated that they used the wind to interpret the weather. Please Refer to Table 8 for other indicators.

**Table 8** LTK interpretations of wind indicators

Behavioral sign	Forecast
<i>Wind</i>	
1. Northerly becoming southeasterly	Rains are expected soon
2. The presence of prevailing southeasterly to easterly winds	Drizzly weather expected soon
3. The dominance of a westerly wind season	Enhanced chances of a good rainfall
4. Northerly to northwesterly winds	Rainfall expected in about three days
5. Very strong winds during a threatening rainfall event	Disturbs good rains
6. The presence of a prevailing easterly wind for a long time	Drought expected
7. Dry southerly winds in summer	A dry spell expected
8. Northerly winds in summer	Rainfall expected within a few days
9. The prevalence of whirlwinds in August	Signifies early rains

Source Field Data (May 2014)

### 7.3.6 Weather Conditions

Domboshawa residents are able to read the weather conditions of their day-to-day living and about 69% of the respondents gave behavioral indicators used to interpret weather as exemplified by Table 9.

## 7.4 Assessment of Climate Variability and Weather Signals in Domboshawa

Residents of the area also look at the circular halo around the moon, known as *dzivaremvura (halo)*, to predict the possibility of rainfall in the coming season and the wetness of that particular period of the season. This is not only peculiar to Domboshawa but this scenario is evident in other parts of Zimbabwe such as Mberengwa (Shoko and Shoko 2011). Other indicators include animal and plant behaviour, as well as wild fruit availability and wind direction prior to the rainy season as alluded to by 82% of the respondents. However, these indicators appear to be dynamic and related to those of western science, which has also tapped into these indicators and uses wind direction to predict rainfall patterns. Overreliance on western science, however, seems to be one of the biggest challenges threatening the sustainability of indigenous knowledge as knowledge dissemination is through the radio a.

**Table 9** LTK interpretations for weather conditions

Behavioural sign	Forecast
<i>Weather Condition(s)</i>	
1. Hazy weather from September to early November	A good rainfall season expected
2. Haze in August	Heralds the early onset of the hot season
3. Appearance of mist on Domboshawa	Rains expected in one to two days' time
4. The occurrence of mist during the morning halo around the moon	A hot afternoon is expected
5. Presence of morning dew	No rains expected for the next 24 h
6. Absence of morning dew	Convective rainfall is favourable
7. Very hot weather from September to October	Good rainfall season expected
8. Lightning in the far north in October	Heralds the onset of the rainfall season
9. Rainbow appearing just before a rainfall event	Failure of the rainfall event predicted
10. Very hot and humid conditions in summer	Signify good chances of thunderstorms
11. Lightning from the west in summer	No immediate rains expected
12. Appearance of cirrus clouds	Perfect conditions for precipitation
13. Extended cold winter	Signifies drought to come
14. Warmer than normal winter	Drought expected the coming season

Source Field Data (May 2014)

## ***7.5 Challenges Related to LTK and Climate Change in Domboshawa***

As discussed earlier, the main problem with LTK is that it is not recorded or documented and therefore the data tend to be fragmented. Upon the deaths of people who possess valuable knowledge, the older generation i.e. those above 65 years the knowledge dies as well. The local community does not have the capacity for documenting LTK so that it can be passed from one generation to another and therefore does not become extinct. Data availability and exchange does not normally occur in the locality due to the lack of capacity and will to document such information. People cope and adapt to climate variability and change in a number of ways. There is also the need to document those coping mechanisms that are not necessarily related to agriculture, but for this to be accomplished, information should be available and those who have it should be willing to share. Due to an increasing dearth of social capital in Domboshawa, forums that were established years ago have been destroyed. However, with the increasing role of social media,



social capital could be harnessed to disseminate information on LTK. The government is not allocating enough funds to disaster management and planning. Funds may arrive only after the disaster has already come, and LTK may not have assisted farmers sufficiently. Hence, there is a need to integrate LTK and meteorological information.

## ***7.6 LTK's Interface with Science***

LTK enables farmers to participate as agents as well as consumers in programs that use modern climate science to plan for and adapt to climate variability and climate change. Who should provide weather information? Whose reality counts? That of the few at the centre of power (elite) and that of the many at the periphery (smallholder farmers)—both are important as explained by 69% of the farmers in Domboshawa. For full participation of the latter, words such as participation itself, ownership and component are quite critical. Hence, we should challenge ourselves personally and professionally as well as institutionally so that reality counts, i.e., weather information should be produced by or with farmers, as local communities are experts on their own reality (Chambers 1996). As of now that local knowledge is not documented at all.

LTK is related to climate science on two time scales: it facilitates communication between indigenous and modern scientific knowledge in the domain of climate variability (Risiro et al. 2012). This arrangement predisposes farmers to be open to scientific forecasts distributed by the MSD and by the media because they already accept a variety of components of knowledge and evaluate these components as the season progresses. Hence, there is a need for the marriage of LTK and scientific forecasts. Meteorologists will therefore be in a position to design forecasts that are relevant and usable (Nyong et al. 2007). Forecasts could show historical patterns, weather observations and regional information, corresponding to sources of information that meteorologists use. LTK is highly social in nature, thus forecasts could be disseminated through innovative forms of forecast dissemination that centre on social interaction, e.g., Facebook and Whatsup, to enhance communication, this response was said by 85% of the farmers. Farmers should therefore be seen as active players in the production, transmission and use of information.

## **8 Conclusion**

Over-reliance on western science, as well as the emerging group of young people who view anything traditional as backward, seem to be the biggest challenges threatening the sustainability of indigenous knowledge in Zimbabwe especially in Domboshawa. On average 71% of the respondents noted that they have used IKS in the past two years to interpret the weather. I therefore call for the marriage of local

knowledge and modern science because applying them in isolation might eliminate the complementarities that could help farmers succeed. This is worsened by the absence of a documenting culture among Zimbabweans. For millennia, the locals have depended on folklore passed from older to younger generations; most of this was through word of mouth. Meanwhile, folklore is quickly fading away as grandparents and grandchildren are scattered all over the world looking for better opportunities. Exposure to new knowledge and cultures in other countries might be contributing to the treatment of local knowledge as primitive and out of touch with civilization. Few people, therefore, look at IKS as integral, and some have only considered using it in times of adversity. Local knowledge is not only important to farming; it is also critical to social, cultural, economic and political development. The lack of a documentation culture is striking when one considers how many publications have been written about Zimbabwe's political leadership by people from outside Zimbabwe. Local voices are usually expressed through the voices of foreign researchers, and our work thus usually goes undocumented and unrecorded.

## 9 Recommendations

There is a need to utilise indigenous knowledge in weather forecasting to supplement conventional weather forecasts from the Meteorological Services Department (MSD). In view of the responses from the respondents, the following recommendations are made:

- Most rural communities are still faithful to LTK for climate risk management, even when most agree that the patterns of the local climate seem to be changing. There is a need to localise climate change discourse so that that villagers can understand what is occurring. There is very little literature on climate change in Zimbabwe; as a result, studies are dominated by examples from Western countries, which are not relevant to the Zimbabwean situation.
- There is an urgent need to integrate indigenous climate risk reduction strategies with western climate information, to provide the local communities with new tools for coping with current climate extremes, and to enable communities to adapt to future climate changes. Synchronization of indigenous weather systems and the conventional meteorological forecasts—to produce a product that is a hybrid of the two forecasting systems is essential in Domboshawa.
- Though indigenous knowledge systems form a strong base of knowledge for Zimbabwean society, they are still shunned due to lack of institutional support. Emphasis should be on developing indigenous knowledge systems, documenting this unique knowledge, and integrating it into mainstream knowledge. In Zimbabwe, there is little documentation of this knowledge, yet it is a viable alternative knowledge base. Policy should be put in place through provision of human and financial resources to support IKS within communities. Zimbabwe does not have a specific policy on IKS.

- There is a high risk of extinction of indigenous knowledge if it is not documented. To avoid this loss, research should be done on the various methods of IKS and should document the effective methods for use by the future generations, especially regarding climate variability and change. Therefore, skills to identify, collect, and develop indigenous knowledge into contemporary usable formats are needed to ensure the sustainability of LTK in the Zimbabwean context.

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