



# Integrating Indigenous Knowledge Systems into Climate Change Interpretation: Perspectives Relevant to Zimbabwe

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## ABSTRACT

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The theoretical paper argues for the Integration of Indigenous Knowledge Systems (IKS) with modern climate change science as a basis for sustainable comprehensive community based response to the impacts of climate change. Climate change is a long-term change in weather patterns resulting from natural and human activity. Human beings have a rich history of oral interpretation of climate change and variability through observing changes in behaviour of living organisms within their localities. Such knowledge could be used in determining timing of important agricultural activities, predicting disasters and in the interpretation of climate change. Climate change erodes global environmental sustainability and the repository of IKS. This paper recognizes the power of IKS and proposes a strategy to incorporate it into climate interpretation. Whilst the indicators of climate change like changes in precipitation, temperature, runoff, biodiversity and ecosystems, water resources, oceanic circulations and others are generally understood in modern climate change science literature there is limited research and integration with IKS. In the short to medium term comprehensive documentation of IKS is required as a basis for a national framework policy on climate change and its impacts.

### Keywords:

climate change, Indigenous knowledge system, integrating, environmental sustainability

## INTRODUCTION

Climate change is a long-term change in the statistical distribution of weather patterns resulting from human activity and from natural climate variability. The impacts of climate change are measured and observed at various spatial scales; from local to global and are a threat to global environmental sustainability particularly its associated risks to indigenous communities and their forms of livelihoods. The climate change debate through the United Nations Framework Convention on Climate Change (UNFCCC, Rio 1992) has magnified the controversies surrounding its debate between the north and south. This has prompted pessimism and skepticism regarding the dimensions and impacts of climate change on the biophysical and socioeconomic pillars of sustainable development. Whilst the indicators of climate change like changes in precipitation, temperature, runoff, biodiversity and ecosystems, water resources, oceanic circulations and others are generally understood in climate change science there is limited research and integration on how some of these would impact on the socioeconomic development of a country like Zimbabwe. This paper explores the possibility of integrating IKS into interpretation and forecasting of changes in climatic elements. The position of this paper acknowledges that indigenous communities have a wealth of experiences that have accumulated over the years and may be built into a reliable and valid climate change interpretation and management of the related risks. In the short to medium term it is imperative that as a nation we document local level biophysical and socioeconomic indicators of climate change with a view to build national data base that will be used to formulate a comprehensive national policy on climate change and its impacts.

Wherever humans have settled around the world, being able to predict the weather has been an advantage. Even without the modern way of dividing the time into minutes, hours, days, weeks, months and years, humans have been able to understand these diurnal and seasonal changes of the environment (Svotwa, Manyanhai and Makanyire, 2007). Such knowledge could be used in determining timing of important agricultural activities and in predicting disasters.

Climate variability has a considerable influence on the success of agricultural production in the rural communities in Zimbabwe. Of great importance in determining agricultural production are climatic elements like rainfall and temperature. Rainfall is the single important element since most communal areas depend on rain fed subsistence agriculture for their livelihood. Others like temperatures and humidity influence availability of moisture to crops through their influence on the rates of evaporation. Communities have lived with and experienced climate-related disasters throughout the time of their existence. Weather related hazards like floods, hail, thunderstorm and strong winds have caused

death of livestock and crops and should be understood in order for protective measures to be taken but man lives by culture rather than instinct in order to remain alive. Droughts in Zimbabwe have become more frequent and severe. The 1992-93 drought, recorded the worst in living memory, caused loss of 60 % of the national cattle herd in Zimbabwe (Ngara and Rukobo, 1992). The excess rainfall, as was experienced in 2000 during the cyclone Eline also affects the well-being of the communities and at times leads to loss of life and damage to property and infrastructure. Losses associated with extremes of weather and climate made the communities in the rural areas of Zimbabwe to develop their own traditional methods to monitor and predict weather.

Before the advent of modern scientific methods rural communities must have realized that some animals, birds, insects and plants had the capacity to detect and respond to changes in the atmospheric conditions. The level of human cultural development also corresponds to suffering when a disaster strikes. They also mastered the positions of stars, the sun and associated shadows and the moon, the wind strength and direction and the cloud position and movement and the lightning patterns, animal and vegetation physiological changes (First Science, 2004). The knowledge about past disasters and climate in Africa are the accumulated experiences that have been handed down to generations through oral traditions in what is referred to as IKS.

Indigenous knowledge is used to describe the knowledge systems developed over a long period of time by a community as opposed to the scientific knowledge that is generally referred to as 'modern' knowledge (Ajibade, 2003). It is the wisdom, knowledge and practices of indigenous people gained over time through experience and orally passed on from generation to generation and has over the years played a significant part in solving problems, including problems related to climate change and variability. Indigenous people that live close to natural resources often observe the activities around them and are the first to identify and adapt to any changes. The appearance of certain birds, mating of certain animals and flowering of certain plants are all important signals of changes in time and seasons that are well understood in traditional knowledge systems. Indigenous people have used biodiversity as a buffer against variation, change and catastrophe; in the face of plague, if one crop fails, another will survive (Salick and Byg, 2007). In coping with risk due to excessive or low rainfall, drought and crop failure, some traditional people grow many different crops and varieties with different susceptibility to drought and floods and supplement these by hunting, fishing and gathering wild food plants. The diversity of crops and food resources is often matched by a similar diversity in location of fields, as a safety measure to ensure that in the face of extreme weather some fields will survive to produce harvestable crops.

IKS is the basis for local-level decision-making in many rural communities. 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. The locality approach in climate science and studies of indigenous knowledge systems provides an appropriate platform for describing and examining the spatial implications of climate change. It is the spring board for effective climate change adaptation studies and applications by local communities. Incorporating indigenous knowledge into climate-change policies can lead to the development of effective adaptation strategies that are cost-effective, participatory and sustainable (Robinson and Herbert, 2001). The locality perspective is more inclusive and responsive to the upheavals of climate change but is usually ignored or unheralded in programming of responses to this phenomenon. This line of thinking, however, faces a number of challenges as modern scientists seem to be skeptic of the capability of such knowledge system in predicting climate change with efficacy as methods and techniques adapted by each community vary greatly and the oral traditions have many gaps given that the knowledge is passed on to the new generations informally. The cultural dimension to the debate may mould perceptions among individuals of a different cultural background. However, such knowledge can be tapped into climate change studies for the benefit of the country.

Local communities in Africa have developed intricate systems of gathering, predicting, interpreting and decision-making in relation to weather. Ajibade and Shokemi (2003) observed that Nigerian farmers were able to use knowledge of weather systems such as rainfall, thunderstorms, windstorms, harmattan (a dry dusty wind that blows along the north-west coast of Africa) and sunshine to prepare for future weather. Indigenous methods of weather forecasting complement farmers' planning and response to disasters. Whilst the current western trained meteorologist bases weather forecasts on global models and satellite imagery the traditional perspective base on lived experiences. This compares well with the findings from Zimbabwe where communities to the western margins of the eastern highlands were able to predict the impending weather conditions based on their experiences of changes in wind flow patterns and directions as well as the behaviours of animal and plant species (Svotwa, Manyanhaire. and Makanyire, 2007). A similar study in Burkina Faso showed that farmers' forecasting knowledge encompasses shared and selective experiences. Elderly male farmers formulate hypotheses about seasonal rainfall by observing natural phenomena, while cultural and ritual specialists draw predictions from divination, visions or dreams (Roncoli et al., 2001). These visions however, are usually confined to the elders and spirit mediums that are closer to God and the ancestors. Not everyone has these seemingly spiritual skills to effectively forecast climate change. The most widely relied-upon indicators are the timing, intensity and

duration of cold temperatures during the early part of the dry season, timing of fruiting by certain local trees, the water level in streams and ponds, the nesting behaviour of some birds, and insect behaviour in rubbish heaps outside compound walls (Roncoli et al., 2001).

African communities and farmers have always coped with changing environments. They have the knowledge and practices to cope with adverse environments and shocks. The recognition and adoption of these knowledge systems is important in mapping out a comprehensive national response to the issue of climate change. The enhancement of IKS capabilities is key to local level inclusion strategies in the development process (Leautier, 2004). Apart from the general understanding of climatic and hydrological impacts of climate change it would impact negatively on the social structure of rural livelihoods and the indigenous technical treasure system as their environments become degraded and the supporting ecosystems disappear. Communities are likely to change survival patterns including migrating to urban settings where such knowledge is no longer usable due to profound changes in cultural traits. IKS fully develops in areas where the people have a long history of residence and have become to be more integrated with their biophysical environment. They become knowledgeable of tree species and varieties that produce the sweetest fruits their physiological changes with change in seasons, they have records though inaccurate at times of the years when these valuable tree species could not bear fruit and the weather patterns associated with such physiological changes. Whilst there is agreement in approach in modern weather forecasting science in the indigenous context the knowledge has spatial gaps as traditions are locale specific and lack documentation of the techniques that are required to read climate changes. Most communities always exhibit loss of the traditional richness in the interpretation of a variety of traditional practices related to rainmaking ceremonies for example. These vary greatly from the eastern, northern and southern parts of Zimbabwe. The spatial discontinuities in knowledge provide opportunities for in-depth studies of the different practices and their relevance to a national climate change policy. In the modern weather and climate studies analysis of historical data has pointed towards changes in temperature and rainfall using a variety of statistical calculations and modeling. Such techniques are not available in the traditional formats of measurement and evaluation of climate change but the indigenous way they rely on personal experiences enhanced by long times of stay in the area. Interestingly, both sides of climate change knowledge have margins of errors that need to be explored further.

People are better able to adopt new ideas when these can be seen in the context of existing practices. A study in Zimbabwe observed that farmers' willingness to use seasonal climate forecasts increased when the forecasts were presented in conjunction with and compared with the local indigenous climate forecasts

(Patt and Gwata, 2002). Local farmers in several parts of Africa have been known to conserve carbon in soils through the use of zero-tilling practices in cultivation, mulching, and other soil-management techniques (Dea and Scoones, 2003). Natural mulches moderate soil temperatures and extremes, suppress diseases and harmful pests, and conserve soil moisture. The widespread use of indigenous plant materials, such as agrochemicals to combat pests that normally attack food crops, has also been reported among small-scale farmers (Gana, 2003). It is likely that climate change will alter the ecology of disease vectors, and such indigenous practices of pest management would be useful adaptation strategies. An understanding of the micro-climatic changes and their impacts on the socio-economic development of a locale is more important than the generalized regional models advanced by modern science. Local communities have been known to use controlled bush clearance as a means to minimize the washing of soil surface nutrients by runoff and to use green manure and protecting river banks.

The African pastoralists are known to have expertly adapted to their environments as a way to reduce the seasonal and long term shifts in climate. Some of the strategies used include use of emergency fodder in times of drought, culling of weak livestock for food, and multi-species composition of herds to survive climate extremes. During drought periods, pastoralists and agro-pastoralists change from cattle to sheep and goat husbandry, as the feed requirements of the latter are lower (Seo and Mendelsohn, 2006). The pastoralists' cyclic and seasonal movements within the Sahel reduce the pressure on low-capacity grazing areas. This practice has become more difficult in regions where there has been sharp population growth against an accelerated shrinkage in forests and grazing land. African women are known to possess indigenous knowledge which helps to maintain household food security, in times of drought and famine. They rely on indigenous plants that are more tolerant to droughts and pests, providing a reserve for extended periods of social hardship (Ramphel, 2004; Eriksen, 2005). In southern Sudan, for example, women are directly responsible for the selection of all sorghum seeds saved for planting each year. They preserve a spread of varieties of seeds that will ensure resistance to the range of conditions that may arise in any given growing season (Easton and Roland, 2000). In Zimbabwe women particularly the old ones are good in preserving traditional varieties of nuts, millet and cowpeas that will be consumed during times of scarcity.

The climate change movement has focused on the issue of impacts on the economy based on the impacts-led approach to a vulnerability-led approach in climate-change science with limited integration though of the existing experiences in climate change knowledge. Externally driven adaptability is most likely going to fail and above all accelerate the rate of resource depletion if the rich knowledge of the local communities is not adequately captured and understood. It will remain a

money spinning venture for those in the academia and non-governmental organisations who have carved a niche into adaption and vulnerability thesis. Despite knowledge of the potential of IKS to contribute to climate science debate there is limited integration. Zimbabwe would benefit from more concerted efforts towards integration of IKS with modern climate change knowledge with a view to understand the interactions between vulnerability and adaptation to climate change and variability and the consequences of climate variability and change both in the short and long term.

### **Indigenous climate change interpretation**

This subsection highlights some of the traditional techniques used by local communities in interpreting weather and climate change and to survive against the adversaries of weather (Svotwa, Manyanhaire and Makanyire, 2007). Some of these observations are shown on Table 1.

The techniques that are available can be classified into those that have to do with change in behaviours including mating, movements, sounds and reproduction patterns for animals. Plants have been critical in forecasting weather patterns particularly the likely levels of rainfall and this is usually observed through flowering patterns. The unfortunate part is that the flowering and mating patterns are confined to specific geographical locations. Some of these observable and predicted behaviours are described to demonstrate that it is possible to on an integration framework for climate change. The migratory tendency of the white and black stock could be associated with the approaching summer season. Modern scholars have also reported that many animal species undergo movements of varying distances depending on the prevailing rainfall patterns. In paleoclimatic studies it has been established that organisms of a specific genera were associated to the prevailing type of climate and that changes in their composition could have been driven by changes in temperatures and rainfall patterns.

Short term variations in temperature may prompt migration as some like the stock pursue moist and warm conditions where food is plenty. Example of a bird whose presence is rain associated is the Woodland Kingfisher of West Africa, the swallow and the white and black stock. The Zimbabwean type of kingfisher is associated with heavy falls within days of its appearance as the interpretation is that the nature of the sound that it produces resembles clattering of rain drops characteristic of a heavy downpour. The short term response measure to such kingfisher sounds has been land preparations to take advantage of the impending rains. The movement of ants emerging from their holes in large numbers to collect food from homes and the veld in some parts of Zimbabwe has traditionally been associated with an impending long wet spell. This knowledge is a privilege of the elderly in the community those who have lived the experience and are able to

relate to nature in a more meaningful way. There is an adage that says if you want to hear the cough of a crab you go to the river. Those who have gained experience in reading the behaviours of particular animals in ecosystems have had the patience to closely study them. The ants disappear less than twenty-four hours before the storm. Ant behavior triggers farmers to collect firewood to dry places in preparation for a long wet spell. The current generations in the rural parts of Zimbabwe fail to interpret this behaviour as they see the ants as a nuisance and fail to link this to the impending weather conditions. Elsewhere ant behaviour has long since

been regarded as a portent of rain to come (Australian Broadcasting Corporation, 2006). If ants seem hyperactive or if they build high walls around the entrances to their nests then it will rain and seeing them in strange places like the ceiling or ice chest was another sign of rain (Australian Broadcasting Corporation, 2001). However, in some areas the ants themselves have disappeared as the threat of climate change on biodiversity gathers momentum and their ecological functions not recognized by the current generations.

**Table 1 use of IKS in climate change interpretation**

| Feature                    | Observation                                                      | Prediction                                                 | Implications                                                                                                                                                                  |
|----------------------------|------------------------------------------------------------------|------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Swallows                   | Large swarms                                                     | Wet conditions Approaching                                 | Land preparations in the field                                                                                                                                                |
| Swallows and water fowls   | Lay eggs on raised patches in river valley                       | Floods                                                     | Planting on wet land and gardens in river valley can be avoided                                                                                                               |
| Swallows and water fowls   | Breed on the ground under cover of grasses and reeds             | Low rainfall to drought conditions                         | Early crop in river valleys and wetlands will be beneficial. Drought tolerant crops like sorghum, rapoko and pearl millet should be planted on the greater part of the field. |
| White and black stock bird | Large numbers                                                    | Normal to above normal season                              | No need to panic. Normal cropping programme can be followed                                                                                                                   |
| Black and brown ants       | Collecting food in the houses in large numbers                   | Long wet spell                                             | Impending heavy rains: flooding nutrient leaching<br>Collect firewood to dry places                                                                                           |
| Black and Brown ants       | Bring out the dead and damp food after a wet spell               | Short dry weather after which the rains will resume        | No need to rush into the field to cultivate, as weed will re-establish when rains resume.<br>Fertilisers will be washed and leached                                           |
| Cicada                     | Singing and in large numbers                                     | Normal to above normal season. Wet conditions approaching. | Land preparation in field should kick off                                                                                                                                     |
| Elders                     | High frequency of drinking water                                 | Wet conditions approaching                                 | Plan accordingly                                                                                                                                                              |
| Fire                       | Spontaneous fires in the sacred Mountains                        | Early rains and an above average season                    | Plan accordingly                                                                                                                                                              |
| Wind                       | Cold Westerly wind                                               | Dry weather                                                | Weeding should continue<br>Cut weeds will not reestablish                                                                                                                     |
| Wind                       | Damp north easterly                                              | Wet weather in 24 hours. Light showers most likely         | Fertilizers can be applied in between the showers                                                                                                                             |
| Wind                       | Heavy and stormy towards the direction from which rain is coming | The rains will disperse                                    | Continue working in the field                                                                                                                                                 |
| Wind                       | Gentle winds in the direction of the rains                       | Wet conditions within six to twelve hours                  | Normal work                                                                                                                                                                   |
| Clouds                     | Low cloud perching on Mountains                                  | Wet spell for about a week                                 | Weeds can re-establish                                                                                                                                                        |
| Clouds                     | High dispersed cloud                                             | Dry weather                                                | Weeding can continue                                                                                                                                                          |
| Clouds                     | Clear sky, but heavy clouds appearing on                         | Storm within 6 to 24 hours                                 | Take refugee in time                                                                                                                                                          |

|                                  |                                                                               |                                                                      |                                                                                                                  |
|----------------------------------|-------------------------------------------------------------------------------|----------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------|
|                                  | the eastern Horizon                                                           |                                                                      |                                                                                                                  |
| Clouds                           | Low cloud after rains                                                         | Mark the end of the wet spell                                        | Fieldwork can resume                                                                                             |
| Clouds                           | Different types                                                               | Variations in weather                                                | Advise accordingly                                                                                               |
| Sky and Atmosphere               | Strong haze in September<br>Called <i>maomi</i> in local                      | Above average season                                                 | Normal preparations should be done                                                                               |
| Sky and Atmosphere               | Red sky in the west towards sunset                                            | Dry conditions persist                                               | Danger of an agricultural drought                                                                                |
| Sky and Atmosphere               | Clear blue sky or with clouds of great vertical extent in the eastern horizon | Rainfall expected within 12 to 24 hours                              | Prepare accordingly                                                                                              |
| Sky and Atmosphere               | Hot and damp conditions after rains                                           | More rain expected                                                   | Do not weed. Avoid going in to the river                                                                         |
| Sky and Atmosphere               | Cold winds after rains                                                        | Dry conditions to follow                                             | Prepare to work in the fields                                                                                    |
| Moon                             | Full phase to new moon period                                                 | Rains expected to "clean" the new moon                               | Hope for resumption of crop growth after a dry spell. Weed crop for fertilizer applications when the rains fall. |
| Moon                             | Cloud conditions, no rains up to half moon                                    | Dry spell to follow for up to 21 days until full to new moon period. | Danger of an agricultural drought                                                                                |
| Trees                            | Certain wild fruits and berries abundant                                      | Above average season expected                                        | Normal preparations                                                                                              |
| The shooting of the sausage tree | Impending wet season                                                          | Onset of the rain season<br>Preparation for rain making ceremonies   | Land preparation, dry planting of millet begins Sourcing of draught power                                        |
| Sun                              | Glaring sun no much heat output in January and September                      | Low rainfall to drought                                              | Seek for drought tolerant Crops                                                                                  |
| Sun                              | Glaring sun and very hot conditions in January and September                  | Normal to above normal rains                                         | Normal preparations                                                                                              |

Source: Adapted from Svotwa, Manyanhaire and Makanyire, 2007

Intense thirst and a high frequency of drinking water by the elders is a sign that rains will fall. However, the period intervening this behaviour and the coming of rains is not specified. Thirst is related to heavy sweating when there is a high vapour pressure gradient between the atmosphere and the body during hot dry days (Monteith and Unsworth 1990 and Mount, 1979). A high vapour pressure gradient stimulates thirst and apparently on such dry days evaporation rates are high and when the rising water is cooled sufficiently to condense, convectional rains can be received (Barry and Chorley, 1998). The rate of water loss from the body can be linked to the rate to which that water must be replaced. If these two variables do not match then it leads to dehydration and consequently death. The traditional belief systems based on experiences seem to provide the hypothesis that the modern science of weather

forecasting and climate change has to read, gather data and prove its validity and reliability.

The position and the changing size of the moon have long been understood to be an indicator of changing weather patterns in various parts of the world. Simply stated, changes in the Moon's movement can trigger changes in our weather (King, 2005). This could be explained in terms of the four interfacing tides caused by lunar gravitation. If the moon has an effect on the sea tides, then it should control the distribution of water. The effect spreads onto the atmosphere and weather through distribution of the clouds. From a Zimbabwean traditional African perspective the new and full moon phases are perceived as linked to the movements of the rain bearing winds. In most of the cases the elders are more than convinced that during the rain season the new moon has to come with a wet spell. Once the new moon is there 'in

the skies' and no rains have been received that a prolonged dry spell is expected. However, in the interim people can continue with weeding. This usually occurs between the months of December and January a period that has been established also by the meteorological office in Zimbabwe as characterised by mid summer dry spells. The traditional response to uncertainties in climate from an agricultural perspective was to grow crops that were more tolerant to the existing weather patterns including varieties of millets. However, the modernization of the agricultural systems and technological developments in the processing of agro-products favoured maize rather than the local millet grown in the dry parts of Zimunya and Marange communal areas of Mutare District in Manicaland Province. Such areas now have critical food shortages and are heavily depended on food handouts. This scenario is a very good example of the disrespect of the IKS. The integration of this with the modern exotic varieties could have engineered better food crops within the framework of the climate that prevails in these areas.

The breeding patterns of the impala, kudu, birds, and bushbuck to mention a few are also used in seasonal forecasts and disaster prediction. When game animals give birth in large numbers, it signifies a normal to above normal season. The interpretation is that there will enough food to feed the young ones. Most tropical animals become fertile when day length is short so that they parturate in summer when food is abundant (Mount, 1979). However, this indigenous ecological knowledge is under threat due to human pressure on the biophysical environment particularly the extraction of species through hunting and selected harvesting of tree species. If baboons were a delicacy dish for the locals then we would not have them in abundance in the rural environments in Zimbabwe. Thus, specific species are targets some of the animals due in part to the increased hunting and the sharp rise in habitat disturbance. Humans have long since discovered the mysterious reduction in animal birth rates, and survival of wild animals from disasters like drought. Similarly, droughts in Zimbabwe is also anticipated when waterfowls breed on the ground and in lower patches on flood plains. Elsewhere in literature there does not seem to be any predictors of a coming drought, but there are signs of when a drought is going to break. In Australia for example, if hawks sat so close together on a tree branch, that latecomers are not able to land, then the drought had reached its lowest point. Or if ibis's congregated in large numbers in dry waterbeds or cleared flat ground, and did their famous dance for hours on end, then the drought was about to break (Australian Broadcasting Corporation, 2001).

Another good example of animal ability to predict disasters related with the Tsunami struck south East Asia in 2004 and where 24000 people died but wild animals seemed to have escaped the Indian Ocean tsunami. This adds weight to the notion that they possess a "sixth" sense for predicting seasonal quality and impending disasters (Planet ark, 2004). The

interpretation of such wildlife behaviour is essential for locale climate change and weather forecasting knowledge. However, wildlife in Zimbabwe has been reduced in numbers due to a combination of human and ecological factors. Part to the lack of animal diversity stems from the competing needs for grazing land by domestic animals and the expansion of crop agriculture into marginal areas which are habitats to the wild animals. In this regard it becomes difficult for the young generations to tap into the existing ecological wisdom when some of the animals are difficult to encounter. Given the inaccessibility they have to the modern print and electronic media there is a high probability that they entirely depend on their instincts to manage disaster risk.

African elders interpret clouds in the same way as in modern day geography and meteorology. The cumulo-nimbus cloud is associated with a heavy storm with lightning and thunder (Barry and Chorley, 1998). The familiar mackerel sky (cirrocumulus clouds) often precedes an approaching warm front, with a strong likelihood of veering winds and precipitation. Even in the English culture, a morning sun illuminating clouds to the west may be an indication of an approaching depression. The covering of mountain tops by mist signifies the coming of rains within twenty-four hours to the eastern parts of Zimbabwe. Strong condensation at high altitude above sea level is not uncommon. Moist air from the Indian Ocean is forced up these mountains and condenses after adiabatic cooling. After staying in their areas for a long time and by receiving information from oral tradition, the elders have mastered the pattern of wind movement and rainfall. The social patterns of local communities have been changing due to a number of extrinsic and intrinsic factors. The extrinsic factors include immigration of people and culture values from far a field including the coming in of the white settlers. The adoption of the alien beliefs and styles of life has made indigenous knowledge irrelevant in the face of those who had embraced modernization as articulated by the settlers. The intrinsic factors are grouped around the spatio-temporal variations of culture as induced by societal dynamism. A major attribute to this was the conflicts among leaders and leaders in society, particularly the failure to adhere to the perceived ways of conducting cultural ceremonies that are linked to droughts. These disputes are often linked to the frequent occurrence of droughts. The frequent droughts that are experienced the world over cannot escape the human-to-human conflicts and the human biophysical environment conflicts. Climate change takes in a number of parameters from the socio-economic conflicts that affect our world today, to an extent that the conflict-drought linkages that are given by the elders may not be void of the truth of weather forecasting and disaster management.

Spontaneous fires on mountains in September and October are regarded as a sign of a good season. When these sacred mountains ignite spontaneously as the summer approaches, it signifies the coming of rains

within a week or so, and activities like land preparation and dry planting of pearl millet, rapoko and vlei maize normally start. Calvert (1993) wrote of 'a rare to occasional fire in the late hot to early rainy season reaching aerially destructive proportions only in relatively small areas or patches of, say, 0.01 ha to a hectare or two before being extinguished by accompanying rain' that is common in Zimbabwe. Though the smoke that is released into the atmosphere is not fixed the presence of smoke makes the sky haze and the chances that it adds to the impurities in the air around which condensation takes place are high. Given this underlying fact the locals will be correct to relate the spontaneous fire outbreaks to the formation of rain. The indigenous methods emphasize oral tradition, beliefs that are passed from one generation to another and not in recording the information in documents that could be read by the future generations. This always bring some inaccuracies on relying on traditional forms of forecasting but then the modern approaches always work with margins of error that could be also misleading in terms of drought forecasting and mitigation. The issue of fire in Zimbabwe since the year 2000 has become misleading since most of the veldfire incidents and events are tracked back to the newly resettled farmers. These current fires start as early as May and its link to meteorological changes will be grossly erroneous.

The colour of the atmosphere and the sky are also regarded very useful in predicting weather. For example persistent coldness after the month of August is a sign of dry spells or late rains in Zimbabwe. The cold wind experienced could be the passing of the cold front after a mild to strong storms (Barry and Chorley, 1998). Persistent cold fronts coming into the country from the southeast coast of the Indian Ocean are not unusual and they might have effects on the starting of the summer season as the land is cooled, conditions that are not ideal for convective rainfall. However, the cold fronts are also responsible for frontal rainfall in the Eastern Districts of Zimbabwe. Cooling of the land could only be ideal for the growing of crops like wheat but are not suitable for maize and millet crops. Equally important is the direction of the wind. Locale communities have also developed skills of relating wind direction and its characteristics as defining features of the impending weather which shows a strong understanding of the microclimate of the area by the residents. The high ground usually experiences orographic rains that are usually persistent from mid to late summer in the area.

The local people seem to have learned a lot from the behaviour patterns of the rains and winds that occur in their areas. Farmers expect prolonged dry spells when persistent winter coldness extends into spring. This weather pattern is often characterised by whirlwinds that raises a lot of dust. The dust causes the redness of the sky at sunrise and sunset, a phenomenon called *hore tsvuku* in local language. The redness of the sky, which depends on the amount of dust particles in the air, is regarded as predictor of long dry spell. Similar interpretation is given in Britain where a red sunset also

suggests that dry weather is approaching (British Broadcasting Corporation Weather, 2006). Low clouds after the rains mark the beginning of dry conditions after rains. Geographically, a low cloud is a sign of temperature inversion, when warmer air is above cooler air. Low cloud forms when the air near the ground cools and cannot hold as much moisture, causing water droplets to condense to form fog and mist. The presence of a low cloud shows absence of strong convections and is a clear sign of dry weather in the short term (British Broadcasting Corporation Weather, 2006).

## CONCLUSIONS

Indigenous knowledge system at local level can be integrated with the modern understanding of climate change in various ways;

- Give indigenous peoples space and powers to share their observations, concerns and views on the impacts and climate change.
- Capture Indigenous Peoples' views on climate change adaptation.
- Create inclusive and participatory platforms that increase the visibility, participation and role of Indigenous Peoples at local, national and international levels.
- Document, discuss and promote public awareness on IKS that can be integrated into modern climate change interpretation.
- Promote strategies and solutions that integrate the cultures and practices of the traditional knowledge of Indigenous Peoples.
- Develop a national climate change policy that acknowledges the potential of IKS in generating credible indigenous assessments of the effects of climate change, risks and adaptation strategies.

Basing on some of the themes stated above an effective method to capture this ecological, climatic and biophysical knowledge among the traditional rural communities in Zimbabwe it will be necessary to profile the reservoir of traditional technical skills that exist among the communities in Zimbabwe. An extensive study of these knowledge system and recording in the form of booklets that chronicle the Indigenous knowledge systems of the different groupings in Zimbabwe particularly the remote communities along The Zambezi River for the mere fact that they still have a strong physical relationship with the biophysical environment. It is these communities that suffer the most when the environments are degraded and ecosystems are substantially altered to reduce their services and functions within given localities. These communities suffer the most risk and their adaptation to specific geographic locations is altered through climate change resource degradation and acute environmental pollution.

They contribute less to global environmental pollution but the most endangered communities.

Whereas most precipitation models and records mainly focus on changing amounts of precipitation, indigenous people also emphasize changes in the regularity, length, intensity and timing of precipitation. Whether or not scientific models are incorporated into local explanations depends on the status and accessibility of science within a culture and on the influence of the communications media (Salick and Byg, 2007). The communication protocols have a tendency to marginalize the indigenous communities such communication has to be changed towards models that are more inclusive, participatory and simplified to capture the traditional understanding of climate change in the local language. Conflicting signals have been sent to the local communities through policies

that are top-down and external to the requirements of the local communities. Such policies were driven by the general understanding of the process of modernization implemented by individuals who considered themselves civilized and the traditional communities as primitive. This disregard of the local knowledge has propelled the climate change related problems that we are experiencing today. Thus, accepting that there is indigenous knowledge that can be integrated with modern climate science is acknowledgement of the power of cultural belief systems and a way to restore authority. There is much to learn from indigenous, traditional and community-based approaches to natural disaster preparedness. Indigenous people have been confronted with changing environments for millennia and have developed a wide array of coping strategies, and their traditional knowledge and practices provide an important basis for facing the even greater challenges of climate change. Although their strategies may not succeed completely, they are effective to some extent and that is why the people continue to use them. While indigenous communities will undoubtedly need much support to adapt to climate change, they also have expertise to offer on coping through traditional time-tested mechanisms.

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