Step 1:
DM grass yield = 10 000 $m^2$ x 3485,3 g = 774,51 kg/ha 45 $m^2$

Step 2:
Yield after estimated loss from trampling, insects and termites, is 35 % (774,51 kg x 0,65) = 503,43 kg

Step 3:
Estimated utilisation 50 % (503,43 x 0,5) = 251,72 kg DM/ha
Therefore, 500 ha would yield = 125 860,05 kg DM available

Step 4:
A 700 kg mare with foal needs 1,65 LSU (Meissner *et al.*, 1983), 1,65 LSU x 13,5 kg/LSU (3 % x 450 kg)
= 22,28 kg/mare and foal/day
Therefore, this 500 ha paddock offers forage for

$$\frac{125\ 860{,}05\text{kg}}{22{,}28\text{ kg/mare/day}} = 5\ 650{,}28 \text{ mare-days}$$

Step 5:
Attempted grazing period 2 months (60 days)

$$\frac{5\ 650{,}28 \text{ mare-days}}{60 \text{ days}} = 94{,}71\ (95) \text{ mares for 60 days}$$

22 mares + foals for 60 days, 22/95 x 100 = 23,2 % utilisation

The camp was underutilised. Thus, the recommendation was to put more mares into the camp, or to prolong the grazing period.

Mare and foal on 500 ha for 1 year:

700 kg x 3 % = 21 kg/day x 365 days = 7 665 kg DM/year

$$\frac{125\ 860{,}05 \text{ kg available on 500 ha paddock}}{7\ 665 \text{ kg}}$$
= 16 mares on 500 ha

Carrying capacity on conventional terms:

$$\frac{500 \text{ ha}}{16 \text{ mares}} = 1 \text{ LSU}/30{,}45 \text{ ha (700 kg)}$$

$$\frac{125{,}72 \text{ kg DM/ha}}{10{,}95 \text{ kg DM/365 days}} = 22{,}98 \text{ kg animal biomass/ha}$$

## CONCLUSION

In arid and semi-arid areas, horses eat a wide variety of feeds. Horses graze; eat standing hay or fallen grasses, herbs, shrubs and the bark of trees. Horses have teeth and lips that permit them to graze close to the ground i.e. they are able to pick up preferred fallen grass material and herbs from the ground. Therefore, horses are grazers as well as browsers. The principal forage is *Stipagristis uniplumis* (climax) and *Eragrostis rotifer* (sub-climax) palatable, perennial grass species.

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# EFFECTIVE COMMUNICATION OF CLIMATE CHANGE BY EXTENSION AGENTS


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## ABSTRACT

Climate change has often been discussed at conferences, and in meetings and workshops, but it is not known whether society is aware of its continuing vulnerability to this global phenomenon. Agriculture is one of the sectors most affected by climate change, yet only a number of scientists understand the impact of climate change on agriculture. Not even agricultural extension agents, who are responsible for disseminating agricultural information to farmers and communities, understand it clearly. Within the uncertainty that climate change brings, the success of farming activities depends on the extension officer's understanding of and effective communication about climate change, since they are the agents of change. This article suggests guidelines for effective communication about climate change by extension agents.


## INTRODUCTION

Over the past decades, climate change has emerged as one of the most intensely researched and discussed environmental issues ever around the globe. Many climate change studies and assessments point to more and frequent weather disasters to come, with unprecedented consequences on the global population. However, this information is only known and well understood by a small number of scientists and those that interact with them. While climate change has been discussed broadly in workshops, meetings or at conferences, the question remains whether a significant number of the public is aware of their vulnerability to climate change. So far, it is clear that climate change is likely to have major impacts on farming activities in Namibia, with negative consequences on food security, income generation and livelihoods.

In the light of the above, this article attempts to outline some guidelines for effective communication by extension agents in raising awareness and promoting climate change issues in relation to agricultural activities in Namibia. Therefore, it is vital for the extension agents to have a common understanding of climate change; how to communicate about it and its impact on many sectors of our economy, particularly in agriculture. Only once the agents fully understand climate change and its effects on agricultural activities, will they strive to initiate innovative farming practices which will enhance agricultural productivity and farming income, despite global warming. The scientific evidence leaves little room for doubt that our climate is changing and that agriculture will be affected. Hence communication strategies or awareness programmes around climate change need to be put in place in order to ensure that communities or farmers are kept informed and understand this global issue. This will allow them to adopt better adaptation and mitigation mechanisms to cope with the uncertainties of a changing climate.

## COMMUNICATING CLIMATE CHANGE ISSUES

The measurable increase in average global temperatures, termed "global warming" is linked to increases in "greenhouse" gases in the earth's atmosphere (Justus & Fletcher, 2006). When communicating about global warming, the key issues that need to be understood are climate change and climate variability, as well as two complementary issues, namely adaptation and mitigation. When defining climate change one has to understand the difference between weather and climate first. Weather is the current state of the atmosphere on a day-to-day basis for a given area or region, (IPCC and WMO, 2010). Climate, on the other hand, is the average weather of the area over a long period of time; at least over 30 years (IPCC, 2007 & IPCC and WMO, 2010).

Climate change refers to any change in climate over time, whether due to natural variability or as a result of human activity (this is called anthropogenic climate change) (IPCC, 2007). Also, it refers to a statistically significant variation in either the mean state of the climate or in its variability, persisting for an extended period (typically decades or longer) (IPCC and WMO, 2010). In simplified terms, it refers to any long-term significant change in the average weather that a given area experiences. Most scientists believe that climate change is caused by human activities which include the burning of fossil fuels (coal, oil, and natural gas), driving cars, generating electricity, factories, deforestation, or waste disposal. Historically the wealthy countries have been the biggest contributors to greenhouse gas emissions.

Climate variability refers to variations in the mean state and other statistics (such as standard deviations, the occurrence of extremes, etc.) of the climate on all spatial and temporal scales beyond that of individual weather events (IPCC and WMO, 2010). Variability may be due to natural internal processes within the climate system (internal variability), or to variations in natural or anthropogenic external forces (external variability).

Adaptation is the adjustment in natural or human systems in response to actual or expected climatic changes or their effects, which moderates harm or exploits beneficial opportunities (IPCC, 2007). Adaptation involves undertaking action to deal with the negative effects of climate change. Therefore, adjustment mechanisms need to be put in place which include - but which are not limited to - improved cropping and farming systems, introducing drought tolerant crop varieties and the use of heat tolerant livestock breeds, the building of raised infrastructure in flood areas, and rainwater harvesting in order to adapt to climate change.

Mitigation refers to an anthropogenic intervention to reduce the anthropogenic forcing of the climate system (IPCC, 2007). Therefore, mitigation is lessening emissions of greenhouse gasses. Measures must be put in place to reduce the impact of global warming and its effects on human health and the environment. Such measures include, but are not limited to, the use of gas-fired power generation; efficient lighting and the use of renewable energy sources; improved cooking stoves, reduction of charcoal use; and appropriate aforestation or re-forestation.

Apart from these issues, the main question a crop farmer or community will ask is: How will climate change affect my crops and livestock? To respond to this question, one needs to know the climate variables that affect agricultural production. In general, one will think of declining rainfall and rising temperatures, though there are other variables which could be mentioned such as wind speed, hours of sunshine, and humidity. In this article the examples of changing temperature and rainfall will be discussed.

In Namibia, maximum temperatures have been increasing over the past 40 years to exceed 35 °C in many places, whereas minimum temperatures (below 5 °C) have become a less frequent occurrence, suggesting an overall warming (MET, 2010). It is also predicted with a high degree of certainty that Namibia will become hotter throughout the forthcoming years (with a predicted increase in temperatures of between 1 °C and 3,5 °C in summer and 1 °C to 4 °C in winter for the period 2046 to 2065). Rainfall is predicted to decrease by 10 % in the northern and southern regions and by 20 % in the central regions by 2050 (MET, 2010). The most consistent changes will be an increase in late summer rainfall over major parts of the country, and a decrease in winter rainfall in the south and the west of the country. But, how will the increase in temperature and shifting rainfall patterns affect maize (Zea mays) production? Our response to this question is provided by means of the example below.

Example: Maize thrives in conditions of 500 mm to 900 mm of rain during the growing season and temperatures from 21 ºC to 30 ºC (MAWF, 1997 & Mwazi, 2006). With the summer rainfall coming only late in the season for the past 40 years, planting dates also needed to shift from early to late planting in the season. Failure to do so is likely to cause maize to suffer shortages of water at the beginning of the growing season. Planting late during the growing season may also result in maize being submerged by floods due to extreme precipitation received late during a given season. Hence, understanding planting dates and growing period is crucial and needs to be investigated regularly to keep up with the pace of the changing climate patterns. Should the rainfall be below 500 mm (300 mm for example), it will not be enough for the maize to complete its life cycle to reach maturity in that particular season. This is mainly because its requirement (500 mm and above) is higher than what the land can offer (300 mm). As a result, the land becomes marginally suitable (based on rainfall variable only), perpetuating adverse effects to farmers due to reduced yield driven by climate changes.

Since maximum temperatures for the past 40 years have been exceeding 35 °C and minimum temperatures of 5 °C or below have become uncommon, the agricultural sector is likely to be impacted upon with these changes. Such changes in temperature have been taking place in areas formerly ranked suitable (based on temperature ranking only namely a maximum of 30 °C) for maize production. This means that the area becomes moderately suitable as temperatures exceed 30 °C and moves up to a 35 °C to 40 °C range. It means maize will be stressed by losing too much water due to high evapotranspiration as a result of high temperatures. All these are examples of how an increase in temperature and shifting rainfall patterns as a result of climate change, may affect maize production and farmers. Therefore communicating about climate change should focus on real world scenarios in order to shed more light on what will happen to crops when a change in temperature or a shift in rainfall takes place. From this perspective, it is not helpful to use highly scientific words which may be difficult for farmers and communities to understand. The extension agents should use simple language and provide understandable scenarios when communicating about climate change, as well as work closely with climate modellers to predict the changes so that farmers can get the best advice.

## BARRIERS TO GOOD COMMUNICATION

One of the challenges of public education is that awareness and knowledge do not always translate into action. Simply knowing about the effects of climate change is not enough for some people. They need to understand that climate change affects them directly, and that they can do something about it and they need to be motivated to take action. In order to overcome these barriers, communication geared at public awareness and education should provide people with comprehensive information about a subject so that they can better understand it. Thus, the audience can be encouraged to change specific practices or behaviour, for example, a reduction in harmful practices such as deforestation that leads to flooding and land degradation and water and electricity wastage. An increase in practices



that enhance a person's or community's resilience to climate change (reforestation or alternative livelihoods that conserve forest resources, water harvesting; and sustainable agriculture) can also be undertaken.

## EFFECTIVE COMMUNICATION OF CLIMATE CHANGE

Communication involves imparting knowledge with the intent of raising awareness and promoting understanding. Therefore, getting the right message across about climate change by the extension agents to various communities including farmers, will make them: a) understand why climate change issues are so important in their daily activities; b) put together adjustment mechanisms to cope with this climate change phenomenon; c) reduce agricultural production losses related to climate change; and in return become less vulnerable to climate change and d) put together clear adaptation strategies aimed at enhancing adaptive capacity, generate income and improve livelihoods. When extension agents plan to convey climate change messages to the communities or farmers, the goal should focus on creating a community that understands climate change and thus being able to make reliable choices. In doing so, effective communication of climate change will be realised.

Figure 1 below shows the information flow from researchers, agents and farmers or communities. It is clear that extension agents play a vital role in disseminating relevant information to the communities, as they are the middle-man in the communication process. They also receive information from the communities and scientists. For example, a farmer faces agricultural problems (e.g. stalk-borer in a maize field) and then informs an extension agent about it, who will then later discuss the problem with a researcher in the area for further investigation and to determine the cause of and solution to the problem. Once a scientist has found the cause of and the solution to the problem, he informs the extension agent about the outcome. Thereafter an agent is bound to disseminate the

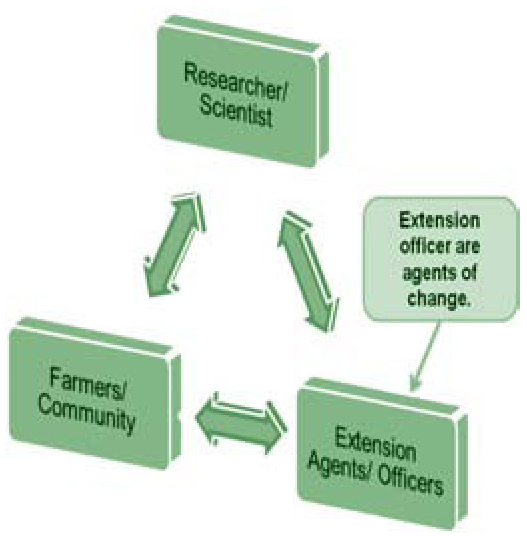


Figure 1. Dissemination link of information flow to different stakeholders.

findings to the farmers, but only after having converted such information to an understandable simple language for the farmers or communities. The outcomes of the findings by the scientist are rarely implemented directly. The findings need to be transformed into a practical oriented approach by the extension agents. Thus, extension officers are the agents of change in fostering rural agricultural developments. Such a process in certain circumstances may require translation of the outcome in the local languages of a community. Therefore, the sooner extension and other service providers become familiar with climate change, the earlier the integration of climate change into agricultural developmental goals.

## RULES OF COMMUNICATING CLIMATE CHANGE

As climate change is a global problem with wide-ranging impacts, it is essential that climate change messages are communicated successfully to many different groups, including town residents, farmers and communities. The aim of a climate change communications campaign is to change public attitudes and behaviour (Table 1). According to GTZ (2009), specific rules to communicate about climate change include:

- Avoid alarmism – base your statements on sound scientific findings.
- Stress the importance both of interpreting climate change and managing uncertainty – use possibility ranges (several plausible and reasonable futures: that is the most important lesson for every decision maker to learn).
- Provide a background of basic climate change science to help decision makers interpret the information.
- Be transparent and precise (and when discussing uncertainty, make it clear what the major sources of uncertainty are – the emission scenarios rather than the models).
- Be exact about timescales (a sea level rise of one metre by 2100 or by 2030 makes a big difference).
- Get support from experts, as they can answer more critical questions and thereby increase credibility.
- Be aware of and transparent about the conflict you are in: on the one hand you might be aware of your own uncertainty and possess inadequate knowledge; on the other hand you want to convince people.
- Try to use neutral language and avoid value-laden statements.

## KEY COMMUNICATION SKILLS

The key communication skills are: listening skills, verbal or speaking skills and writing skills. Therefore, an exceptional listener and communicator who effectively conveys information verbally and in writing, will always get the right message across and will be well understood by the audience. To achieve the expected outcomes, a communication plan needs to be put in place to address questions such as: what change do you want to bring about using communication (objectives), which individuals or

Table 1. Shows a shift in attitude to climate change issues if communication is effective

| Present situation | Expected outcomes |
|---|---|
| Communities/farmers lack knowledge on causes of climate change and do not understand what needs to be done to tackle it. | Communities/farmers clearly understand climate change and what is causing it. |
| Communities/farmers think that climate change will not affect them. | Communities/farmers understand the impact climate change may have on their daily activities. |
| Communities/farmers do not include climate change as an important matter when making decisions. | Communities/farmers include climate change when making their decisions and embrace the positive changes that result. |
| Communities/farmers think climate change is a depressing and negative issue. | Communities/farmers feel empowered and positive about tackling climate change. |

groups do you want to influence (target audiences), what do you want to say (key messages) and who or what are the most effective messengers or champions (community leaders; political leaders or farmers themselves).

## TARGET AUDIENCES AND RELATED PERSUASIVE MESSAGES

It is always important to segment the target audiences during communication. Consequently, developing a profile of the audience is needed to answer questions such as: how do they prefer to get information (written, audiovisual, face-to-face, etc.)? What is the age range of your audience? Are they mostly men or women? And how do they make a living?

Once the audience segments have been determined, develop messages to address them. A good message addresses a particular objective and should be specific. It communicates clearly to that particular audience, links to something they care about and should be believable and backed up by facts or evidence. Messages about climate change should convey a sense of urgency and emphasise the benefits of making the changes being advocated. Therefore, the messages should show that these changes will build resilience, sustain livelihoods and reduce vulnerability. At the end, request feedback from the communities or farmers which could assist in improving and enhancing the message for the future.

## CONCLUSION

To ensure effective communication about climate change, make sure that you understand the issues and concepts before trying to communicate them to others. Speak in plain language; do not use technical, climate change jargon. Keep your messages clear, accurate and simple. Link climate change with other environmental and social issues that might be familiar to people, so that they can understand how the issues are connected. Show the history of climate change, if any, through visuals such as videos, maps, satellite images and pictures to emphasise the importance of this global phenomenon. Last but not least, encourage the audience to integrate climate change into their development goals in order to remain focused, or to take climate change into consideration during the implementation stage of their projects or daily activities.

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# ACCELERATING LANDSCAPE INCISION AND THE DOWNWARD SPIRALLING RAIN USE EFFICIENCY OF NAMIBIAN RANGELANDS

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## ABSTRACT

In response to rapidly degrading rangelands there is an urgent need to precondition the land for extremes of weather conditions, which will both mitigate locally against climate change and offer better rain use efficiency and better primary and secondary productivity. Mainstream principles of rangeland management tend to overlook levels of ecological organisation above the "veld type" as well as dehydration caused by landscape incision and the impacts of infrastructure that initiate and accelerate many erosion processes. Dongas erode soil, but far more ecologically significant is their dehydrating impact on affected surrounding landscapes and their sub-catchments. Prior to incision by dongas, the affected landscapes were usually the most productive in their wider catchment context, staying green longer than adjacent run-off and run-through landscape elements and responding rapidly to local rainfalls. Examples are presented from Farm Krumhuk, approximately 20 km south of Windhoek.

## INTRODUCTION

Rangelands globally face many challenges, not least of which are increasing costs and declining real prices on produce. Climate change is another challenge which appears certain and predictable at a global and continental level, but little real progress has been made to adapt to likely changes for most regions.

Whatever the impacts of climate change, we argue that preconditioning the land for extreme weather conditions will not only mitigate locally against climate change, but also offer better rain-use efficiency and better primary and secondary productivity. In other words, this work should be done, irrespective of climate change scenarios. Such preconditioning aims to get rainfall into the ground as locally as possible and minimise run-off. For both extremes of weather, the conventional strategy is to have high ground cover at a fine scale to capture raindrops into the soil locally, minimise run-off and protect against soil erosion. We argue that it is equally important to restore base levels, where water is held back in the landscape, at a drainage ecosystem level. The purpose of these inter-dependent strategies are to withstand major rainfall events and make best use of small falls of rain in prolonged dry periods. (Base levels are the lowest part of a drainage system beyond which erosion cannot occur. When base levels are incised, for instance when a sandy sill of a wetland is breached by animal paths, then a new phase of erosion is initiated upslope).

While standards of grazing management can certainly be improved and systems such as Savory's Holistic Management (Savory and Butterfield, 1999) and Riaan Dames' Fodder Flow Grazing Management Strategy (Dames, 2009) offer great opportunities, as well as the older Acocks model (Acocks, 1964), they are fundamentally captured in the traditional, local focus (perhaps obsession) with "veld type" dynamics. What all of these models share is a focus on biologically strategic rest (mainly for grasses), an important but inadequate approach to be truly "holistic". That lack of holism is in the sense of levels of ecological organisation above the "veld type" (or "ecological site" in the USA), which is partly our focus in this article. Of particular concern is the increasing incision of catchments and their landscape sequences from valley floor to upland headwaters. These processes do not start and stop in a veld type, but transcend them and thus require a higher level of appraisal than conventional in situ veld management.

Two key additional issues need to be considered along with conventional veld management and like all else, interact as factors determining habitat quality for both livestock and wildlife locally. These are i) landscape incision and dehydration and ii) the impacts of infrastructure that initiate and accelerate many of the former degradation processes. We see these three strands of physical land management as prerequisites to ecosystem ("ecologically") sustainable land management, whatever the land use, culture or location (Pringle and Tinley, 2003; Pringle *et al.*, 2003; Shamathe *et al.*, 2009).

## LANDSCAPE INCISION, INITIATED BELOW AND ACCELERATED ABOVE

Gully or "donga" erosion is often blamed on poor ground cover in the hinterland catchment above. This is not generally correct; increased run-off certainly causes sheeting and extension of erosion cells (Pickup, 1985), but dongas generally need a "nick point"; a cut in the landscape to get started. This may be a track graded below the land surface by just a few centimetres, or a cattle or wildlife