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CLACC

CAPACITY STRENGTHENING IN THE LEAST DEVELOPED COUNTRIES (LDCS) FOR ADAPTATION TO CLIMATE CHANGE (CLACC)

CLIMATE CHANGE AND HEALTH IN UGANDA

DENIVA

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The RING alliance of policy research organisations

FOREWORD

DENIVA is a member of Capacity Strengthening of Least Developed Countries (LDCs) for Adaptation to Climate Change (CLACC) initiative. CLACC is an idea of Southern Institutes working on sustainable development with support from Northern Development Institutes. Thus, considering the degree of vulnerability of LDCs, the CLACC programme is aiming to provide support to LDCs in their efforts to adapt to the impacts of climate change.

CLACC recognizes the truism that adaptation to climate change requires long-term capacity strengthening within governments as well as civil society. The National Adaptation Programmes of Action (NAPA) process, which started under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC), is one mechanism through which national stakeholders can understand the problem of climate change and their role in building resilience to its adverse impacts. However, all these policy issues are not yet sufficiently addressed.

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List of Abbreviations

CIRC	Climate Change Information Resource Centre
CLACC	Capacity Strengthening in LDCs on adaptation on climate change
COP	Conference of Parties
DENIVA	Development Network of Indigenous Voluntary Associations
GHGs	Greenhouse Gases
IIED	International Institute for Environment and Development
LDCs	Least developed countries
MDGs	Millennium Development Goals
MOH	Ministry of Health
NAADS	National Agricultural Advisory Services
NAPA	National Adaptation Programmes of Action
PEAP	Poverty Eradication Action Plan
PMA	Plan for Modernization of Agriculture
UBOS	Uganda Bureau of Statistics
UNFCCC	United Nations Framework Convention on Climate Change
UNHS	Uganda National Household Survey
WHO	World Health Organization

Executive Summary

About 10 million Ugandans are living in absolute poverty. Like all other poor countries in the world, Uganda is highly vulnerable to the impacts of climate change due to its low adaptive capacity. Agriculture and food security, health, energy, water, forestry and biodiversity sectors have suffered serious effects of climate change.

Uganda is facing frequent droughts, floods, and increases in climate sensitive diseases like malaria and cholera. The transmission of malaria has increased in the high altitude areas of the country and is currently the number one killer disease in the country with 88% transmission rate. Malaria is responsible for 22% of deaths among the under 5s in high and medium malaria transmission areas respectively which accounts for about 70,000-110,000 deaths per year. Recent epidemics of *Plasmodium falciparum* malaria have been observed in high altitude of Uganda especially Kabale district (Kabale is one of the districts found in South Western Uganda at the Uganda - Rwanda border). The disease appears to have increased in the 1990s reaching an epidemic level in 1998. Increased malaria incidence in Kabale district has been attributed to changes in land use patterns such as swamp reclamation.

Although Uganda developed its National Adaptation Plan of Action (NAPA) in 2004, the plan has not yet been implemented. Some adaptive measures have been put in place for example, a five year health policy and sector strategic plan (2005/6 to 2009/10) was developed with the overall goal of attainment of a good standard of health by all people in Uganda, in order to promote healthy and productive life and curb malaria. Through this, the country has adopted the use of dichlorodiphenyltrichloroethane (DDT) as one of the preventive methods. The use of DDT spray has already started in Northern Uganda, but is still facing resistance from the farmers, agricultural traders, and the leaders of the Political Opposition Parties.

The findings of the study showed that there is a slight but steady increase in both minimum and maximum average temperatures that correspond to an increase in prevalence in malaria cases during the period of 1997 to 2005 in Kabale district. Altitude and weather influence malaria epidemiology in highland areas because of slowing of parasites development within anopheles vectors at lower temperatures. There is need therefore to develop a multi-institutional research network to better understand climate change and its health, social and economic consequences, as well as develop health risk scenarios periodically using the best available information on climate change anticipated in different ecosystems and assess the potential health risks associated with such changes in the country.

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Section I

1 Climate Change and Uganda

Like other Least Developed Countries (LDCs), Uganda is vulnerable to effects of climate change. According to Uganda's First National Communication (Uganda FNC 2002) report to the UNFCCC, there is low capacity in both financial and human resources to acclimatize to climate change. Nevertheless, there is flicker of hope since Uganda has committed herself in the spirit of global cooperation to actively participate in the global climate change policy processes. So far, Uganda has embraced and ratified most of the climate change related international conventions. She signed and ratified the UNFCCC, on 13th June 1992 and 8th September 1993 respectively. Furthermore, Uganda has indeed participated in and implemented some of the requirements of the COP 7 that were adopted by the National Adaptation Programmes of Action (NAPA) as an additional channel of communicating urgent and immediate adaptation interventions required to minimize impacts of adverse effects of climate change. There is discernible information as far as climate change adaptation is concerned. On paper, strategies towards adaptation are stipulated and linked to relevant national policies despite the fact that many barriers to implementation still remain.

1.1 Vulnerability Contextual Analysis

Uganda is vulnerable to adverse effects of climate change. First of all, it is important to note that Uganda is ranked in the category of the poorer countries at 46th out 50 Least Developed Countries (UNDP, 2006). The number of Ugandans living in absolute poverty - defined as living on less than a dollar a day, had fallen from 56% in 1992 to 44% in 1997/8 and to 34% in 2000. Since 2000, the trends started to deteriorate. Income poverty increased from 34% to 38% just between 2000 and 2003 and decreased to 31% in 2006. According to UBOS report and UNHS collection, 10.2 million people in 2006 were living absolute poverty in 2005/6. Some undesirable changes in poverty trends are manifested by increase in absolute poverty, especially in crop farming households.

Its apparent that with wide spread poverty, Uganda is more vulnerable because of her low adaptive capacities to adverse effects of climate change. "*…poor countries and particularly the poorest people within them are critically vulnerable to shocks that disrupt their lives and livelihoods. Their poverty increases their vulnerability…and it limits their ability to cope with and recover from the shocks…"* (DFID, 2004)

Thus far, with rampant poverty, weak institutional capacity, lack of skills on climate change adaptation and inadequate skills in disaster management, lack of equipment for disaster management, limited financial resources and above all an economy which depends entirely on exploitation of its natural resources makes people in Uganda more vulnerable to the likely adverse effects of climate change.

Uganda has so far experienced an increase in the frequency and intensity of extreme weather events with serious socio-economic consequences. The most extreme event experienced being the El Nino of 1997/98. For instance, floods swept away bridges (many towns were cut off from commercial centre causing heavy losses in goods and services), crops were destroyed, and outbreaks of water borne diseases such as cholera and other flood-related diseases occurred.

1.2 Agriculture and Food Security

Agriculture, which is the backbone of Ugandan economy increased from 29.5% in 2004/05 to 31% in 2005/06 and in a New Vision report of 24th June 2008 shows that agriculture's contribution to GDP decreased from 32% in 2007 to 15% in 2008, over 70% of export earnings and employs about 85% of the labour force. Agricultural performance fluctuates with changes in weather conditions[1]. The lives and livelihoods of Ugandans are dependent on agricultural production. Climate variability, particularly long-term droughts and heavy rain, has been associated with reduced agricultural production; this is expected to worsen with climate change.

Productivity of Uganda's grasslands and livestock is dependent on climate and will therefore be affected by climate variability and climate change. There is also high uncertainty in onset and cessation of rainfall seasons. This coupled with high evaporation rates, particularly in northern Uganda affects agricultural production (Uganda FNC 2002). The increased frequency and intensity of droughts or floods affect food security and household incomes. There is already some predicted increase in temperature by an average of 2ºC, which would drastically reduce production of Robusta coffee that is a major export crop for Uganda therefore limiting it to highlands (Simonett, 1998).

1.3 Health Sector

Uganda currently has a high burden of climate sensitive diseases such as malaria, cholera and dysentery. Heavy rainfalls as especially identified in the El Nino event of 1997/98 triggered water-borne diseases such as malaria, cholera, and dysentery among others.

Malaria does not only cause ill health and death but also has a great impact on the economic development of the individual, the family, the community and the nation. Malaria transmission is high in 88% of Uganda. 63% of people are exposed to high malaria transmission, 25% are exposed to moderate transmission, and 12% live in areas with low or unstable transmission. Therefore, 88% of the total population is at risk from malaria. Malaria continues to be a very serious health problem and the number one killer disease in Uganda today; it currently poses the most significant threat to the health of the population. Malaria currently accounts for:

- 30%-50% of all outpatients' visits at health facilities
- 35% of hospital admissions
- 15% of in-patients deaths

The Health Policy and Sector Strategic Plan were developed within the context of the provisions of the Constitution of the Republic of Uganda (1995) and the Local Government Act (1997). The overall policy goal is the attainment of a good standard of health by all the people in Uganda, in order to promote a healthy and productive life and curb Malaria, which accounts for over 15.4% deaths.

1.4 Energy Sector

The energy sector is predominantly dependent on wood fuel, which accounts for up to 80% of the country's total energy needs. The high demand for fuel wood has resulted into depletion of forests and exacerbates land degradation. The other sources of energy

[1] **http://www.newvision.co.ug/index.php**

are petroleum and hydro-electricity accounting for only 5% and 1.5% respectively. Although Uganda is endowed with renewable energy resources, which include biomass supplies, hydropower potential (over 2,400 MW), solar and biomass residues from agricultural production, they (renewable resources) are not fully exploited which is increasing high demand for wood fuel. The transport sector is the major consumer of fossil fuels. According to the report to UNFCCC, it accounts for about 75% of the fossil fuel import bill.

1.5 Water Resources

Water, which is important for household and community socio-economic activities and production, covers up to 15% of Uganda's total area. Uganda's populations derive considerable economic benefits from water resources in the form of fishing, water supply, transport, hydro-energy and tourism, among others. However, the distribution of water resources is not even such that large parts of Uganda (especially to the North East) are partly semi-arid and face severe water crisis especially during drought periods.

Therefore, the currently increasing frequent periods of drought have had an adverse effect on both the quantity and quality of water resources. More so, problems of flooding from mountain streams are common particularly in Mbale, Sironko and Kilembe district where cholera associated with flooding is common. According to Uganda's Initial Communication to the Conference of the Parties (COP) of the UNFCCC, problems of flooding, droughts, soil erosion and siltation are expected to become more frequent and more severe with the impending climate change and that water demand may not be met especially in the semi-arid regions.

2 Climate Change Adaptation in Ugandan Context

Adaptation to climate change is important to Uganda. As predetermined at the Conference of the Parties (COP) at its seventh session, Uganda has so far adopted National Adaptation Programmes of Action (NAPAs). Uganda has also developed national inventory of GHGs as one step forward to mitigate GHG emissions in her national priorities and aspirations. However, there is limited vulnerability assessment done in a few sectors such as agriculture, water resources and forestry. A lot has been done to communicate urgent and immediate adaptation interventions required to minimize adverse effects of climate change. In addition, Uganda has signed and ratified many climate change international policies. Although national policies have also been developed and updated to acclimatize adverse effects of climate change, implementation is slow.

Some of the significant adaptation intervention so far, includes:

- In the agricultural sector, the Plan for Modernization of Agriculture (PMA) is an important adaptation element which ensures; development of drought resistant cultivars, provision of water for production, agricultural information dissemination, training and research among others.

- Water resources sector adaptation measures call for improved water management systems throughout the country through strict implementation of the Water Statute. Remarkable work can be traced in strict protection of wetlands.

- The National Environment Management Policy promotes the use of economic instruments, public participation and environment information and education. The overall policy goal is sustainable social and economic development, which

maintains or enhances environmental quality and resource productivity on a long-term basis that meets the need of the present generations without compromising the ability of future generations to meet their needs

- The Department of Meteorology is the institution mandated to implement policies related to climate and climate change. The policy goal in this sector is "to maintain a well developed weather and climate monitoring system that provides necessary information and advisories to support sustainable socio economic development."

Despite the improvement in adaptation sectoral strategies, policies linked to adaptation were not merely designed to address climate change issues. There is no holistic policy to govern climate change issues and there is a lot of policy politics in natural resource management. Therefore, in many ways climate change is downplayed and is thought of in the face of disaster. This is coupled with general lack of policy awareness at various echelons of Ugandan society.

3 Climate Change and Health

Science tells us that there is a close link between local climate and the incidence or seasonality of some diseases and other threats to human health (Confalonieri 2007). Extreme temperatures can directly cause the loss of life. Ultimately, warmer temperatures can increase air and water pollution, which in turn harm human health. Global warming is likely to increase the risk of some infectious diseases, particularly those diseases that appear only in warm areas. Increased temperatures allow disease transporters/vectors like mosquitoes, ticks, and mice to thrive.

It's estimated that climate change currently contributes to 150,000 deaths and 5 million illnesses each year (WHO 2003). The majority of these deaths are in Africa.

3.1 Controlling Malaria in Uganda

Achieving the MDGs requires serious investment in areas such as public health. Thus, the best way to go is maintaining robust public health programmes to monitor, quarantine, and treat the spread of infectious diseases and respond to other health emergencies as they occur. It should be acknowledged that there is growing concern of the need for greater efforts to mitigate malaria. Taking action on malaria is important not only because of the human misery the disease causes, but also due to its adverse effect on livelihoods, which creates further human desolation.

There is a need to refocus on improving mitigation and adaptation technologies and community knowledge of climate change science, economics, and responses. The government of Uganda therefore must concentrate on ensuring that policies that foster economic growth perform. These include stable and accountability, the rule of law, strong protection of property rights and friendly trade policies among others.

The question of sustainability should be addressed. Many households are currently unable to afford insecticide treated nets (ITNs), drugs and other tools. Heavy government and donor community subsidies are still badly required in health sector. Funds further need to be committed to supporting the vulnerable poor and provide low cost or free treatment and vector control where appropriate. Common sense prevails

that malaria caused deaths are low in richer households. More so, public health tools would be reasonable enough to allow poor individuals make more choices and give them more power over control of public funds.

More efforts may be needed to reduce bureaucratic impediments to producing, importing, distributing and marketing anti-malaria products and drugs. This includes working with the Medicine Control Councils (MCC) in various countries to ensure that registration times for new drugs are reduced. But, MCCs also need to make real steps towards greater cooperation, streamlining, efficiency and recognition of registrations in other countries.

Section II

4 Case study: Malaria in Kabale highlands

4.1 Introduction

This study was done in Kabale district, especially looking at highland malaria. Natural transmission of malaria depends on the presence of and relationship between the three basic epidemiological factors: The “host”, the “agent” and the “environment”. Variations in climatic conditions have a profound effect on the life of a mosquito and on the development of malaria parasites. Climate change influences malaria transmission patterns and variations in seasonal incidences. The most important climatic factors are temperature, rainfall and humidity.

1. Climate: Climate restricts the range of vector-borne diseases, while weather affects the timing and intensity of outbreaks. Aspects of climate change are important in determining how serious the health impacts are likely to be. These include:

- The overall warming trend
- The disproportionate warming of nights
- The increase in extreme and severe weather events

Upsurge of vector and water-borne diseases often occur during El Nino events. Flooding creates fresh breeding sites for mosquitoes.

2. Temperature: Temperature has a profound influence on the development cycle of the malaria parasites. The body temperature of the mosquitoes is directly related to the environmental temperature. Malaria parasites cease to develop in the mosquito when the temperature is below 16ºC. The malaria parasites that the mosquito injects into the humans (P. Falciparum sporozoites) can only develop at temperatures above 18ºC. The best conditions for the development of Plasmodia in the Anopheles and the transmission of the infection are when the mean temperature is within the range 20-30ºC.

3. Humidity: A high relative humidity lengthens the life of the mosquito. The lifespan of the mosquito is an important factor in the development process of the malaria parasite in the vector. Consequently, high relative humidity allows the parasite to complete the necessary life cycle so that the mosquitoes can transmit the malaria infection to several persons.

4. Rainfall: The association of malaria with rainfall is due not only to greater breeding activity of mosquitoes, but also to the rise in relative humidity and higher probability of survival of female Anopheles. The scenario here is that not only the total amount of rainfall is important but indeed its weekly and monthly distribution.

4.2 Background Information on Malaria and Uganda

The available literature about malaria in Uganda is concentrated on the hyper endemic transmission and very little is specifically about highland malaria. Poor record keeping associated with political turmoil and collapse of the health system in the 1970s and 1980s has left malaria situation not well documented. All fevers are taken as malaria

until proven otherwise. This clinical diagnosis limits the value of the official records leading to gross under estimation. Moreover, only cases where a blood slide has shown malaria parasites are documented.

Recent epidemics of *Plasmodium falciparum* malaria have been observed at high-altitude in Uganda, especially Kabale district. Increased malaria incidence in Kabale has been attributed to a variety of environmental changes. Highland malaria has returned to Kabale district after an absence of nearly 30 years when it was eradicated using DDT spray in 1961. The disease appears to have increased in the 1990s reaching an epidemic level in 1998. Altitude and weather influence malaria epidemiology in highland areas because of the slowing of parasite development within the anopheles vectors at lower temperatures. Increased malaria incidence in Kabale district is variously attributed to changes in land-use patterns such as swamp reclamation.

Population migration has also been believed to increase the spread of the malaria parasite. Increase in mosquito vector populations and breakdown in provision of health services especially insecticide spraying as well as drug resistance (chloroquin and fansidar) could have contributed. The methods of malaria prevention in Uganda include early diagnosis and prompt treatment, in door residual spraying, use of insecticides treated materials and intermittent preventive treatment of pregnant women using fansidar in the second and third trimester. However these methods are not on the ground all the time. So due to lack of access to the above methods, it is easy for people to get malaria.

4.3 Scope of the study

The overriding objective was to describe the role of climate (observed climate warming, and climate variability) on malaria in Kabale district. Specific objectives were:

1. To gather malaria prevalence data and time series from Kabale district.
2. To find climate data (rainfall/ temperature) for Kabale for that particular period and analyse data in terms of changes overtime.
3. To explain reasons for changes overtime

This study was conducted in Kabale district between April and July 2006. Kabale district is located in southwestern Uganda covering 1,827 sq km. Population is one of the highest in Africa estimated at 629,400 in 2000 as per report on 30/04/2008. The population density is 344.5 persons per sq. km. Altitude in the district ranges between 1,219m and 2,347m. Climate is of a mountain nature with a bimodal rainfall pattern. It has two main rainy seasons; March to May as the heavy rains and September to November as the light rains with intervals of some dry spells. June to August is the main dry season and December to February is the short dry period. The mean annual rainfall is 1,092 mm and mean annual temperature is 18° C[2].and mean monthly temperature of 15-20 degrees Celsius. The relative humidity ranges between 90-100% in the morning and decreases to 42-75% in the afternoon all year round.

4.4 Methods

Various methods were used to collect data. Local experts were interviewed. An assortment of people were interviewed namely the local leaders/elders, health workers from health centers, office of the District Director of health services, National Malaria Control Programme, and teachers in the local schools that had been in the area for more than 10 years in Kabale district. We discussed with the meteorological group observed

[2] //www.kabale.go.ug/modules/smartsection/item.php?itemid=2

changes in rainfall and temperature patterns over the above period. We sought people's views on:

1. Influence of rainfall on malaria cases
2. Whether temperature had contributed to increase in malaria cases
3. Whether Malaria cases varies with altitude
4. Malaria cases and swamps
5. Malaria cases and farming

Data Collection

Content analysis was one of the techniques used during data collection; this entailed exploring for the available literature on malaria right from 1919 when it is reported that the first health workers noted the endemicity of malaria in Kabale district around lakes Bunyonyi, Mulehe and Mutanda. The field excursion involved investigating how malaria was eradicated in Kabale in early 1960s and it's re-occurring in the late 1970s. Malaria records in the office of the Director of Health Services were examined. It was observed that no records were available for before 2002 when the offices where burnt. Available data was then collected on the prevalence of malaria. However the data available was only of the confirmed cases (B/S+) and the unconfirmed cases were treated but not documented.

Health Centres Fours (HCIV) were visited to study the archives. Equally, the two district referral hospitals in the region were visited. These include Kabale, and Kisizi hospitals. Information was also thought from National Malaria Control Programme but it was scanty as the programme started recently in 1995. In order to be at the crossing point between climate and malaria, there was an endeavour to seek information from Kabale meteorological unit. Data on monthly maximum and minimum temperatures from 1991 to present 2006 were obtained.

4.5 Results

Malaria Trends.

Interviews with various groups indicate that there has been a hoist in malaria cases in recent years. To ascertain this aforesaid assertion, the graph shown below was developed and it dots monthly malaria cases recorded in Kabale health units from 1997 to 2005.

Figure 1: Seasonal pattern of Malaria Cases in Kabale District (1997-2005)

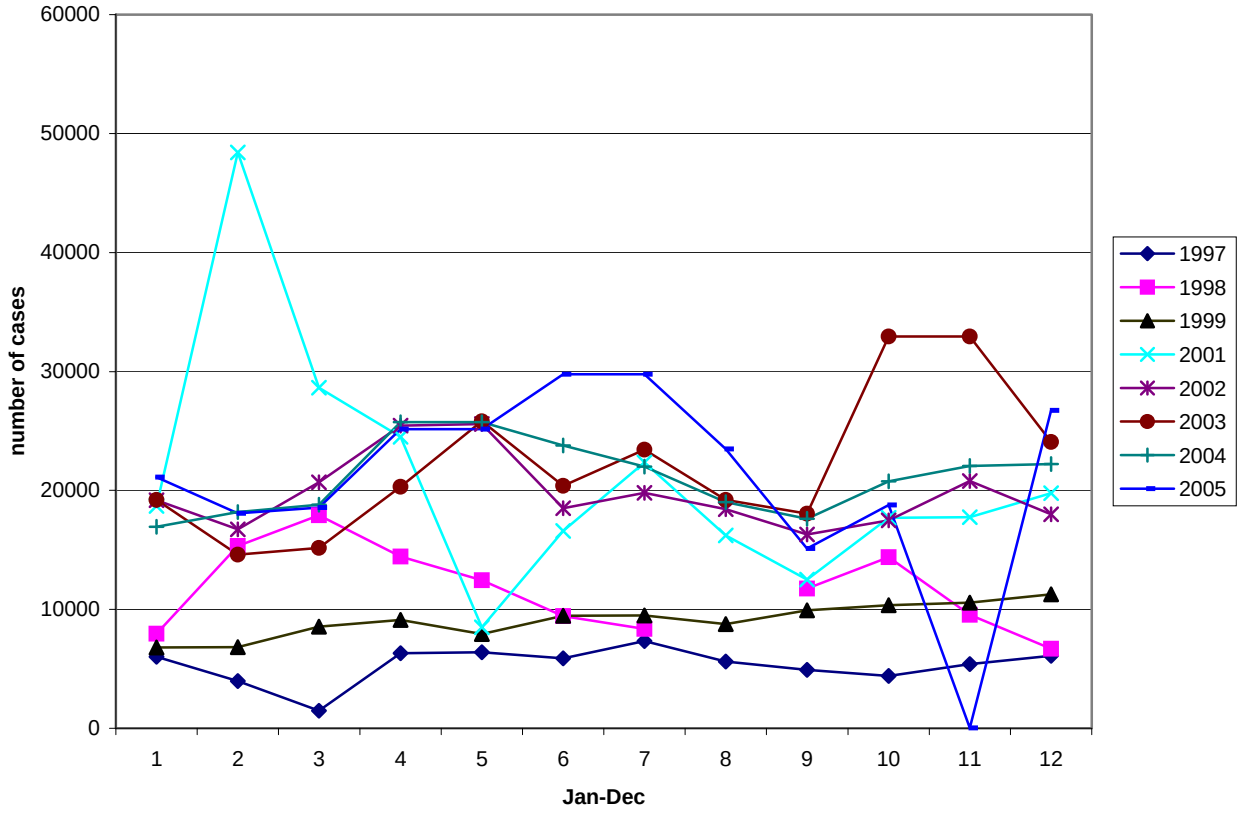
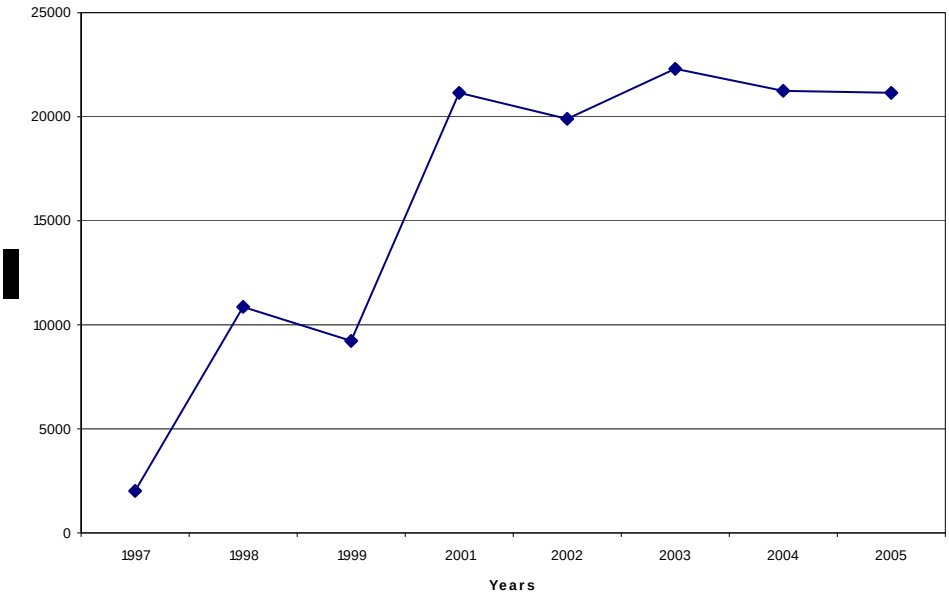


Figure 1 shows seasonal and year to year variation in malaria cases especially with the unusual dramatic increase and fall in the year 2001. Generally, this chart might suggest an increase in cases although most of the data were not accurate. All fever is treated as malaria and it is only through diagnosis that cases are recorded. Increase in the cases could be as a result of general awareness on health related issues, which have significantly improved especially in malaria and HIV/AIDS reporting. Health awareness campaigns have increased the number of patients reporting to health facilities since 1996.

The major challenge was that the numbers of private health facilities in the district have increased and that it is difficult to collect data from them hence the figures may not be the true reflection. Reported figures are only confirmed cases (where microscopy has been done) and yet many health facilities use clinical grounds rather than blood testing while diagnosing malaria. Moreover, such cases are not properly documented. The population of Kabale district has increased and the increase in the malaria cases is expected since malaria is the commonest leading cause of morbidity and mortality in the district. It was noted that the health system and malaria control came to the stand still in early 1970s and 1980s during the political turmoil in Uganda hence the mosquitoes got a chance to be infected.

Fig. 2: Monthly Average Malaria Cases over the period 1997-2005



The above graph shows the monthly average malaria cases per year. There has been a general rise in the monthly average malaria cases since 1997 and from 2001 the endemicity appears to have changed keeping higher than 20,000 cases per month.

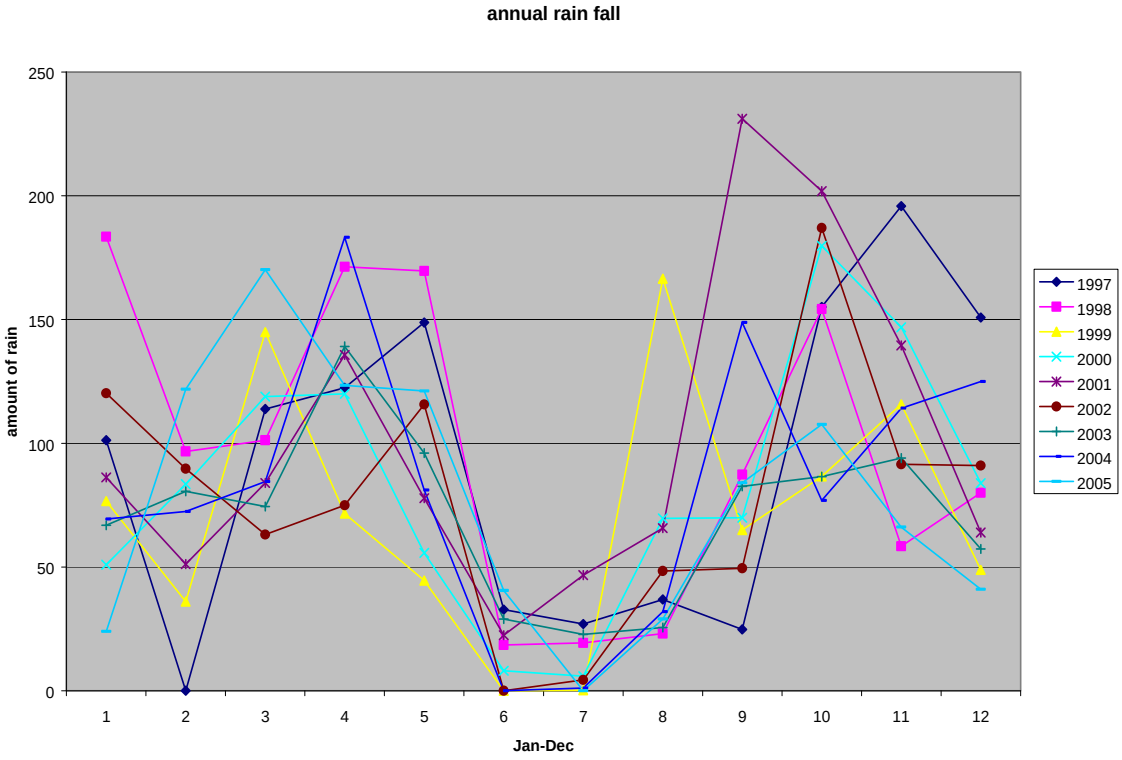
Oral traditions and perceptions from Kabale communities have it that the area has become hotter than before and this is attributed to swamp reclamation for both daily and agricultural farming. People living in low lands are said to be more susceptible to malaria than those at a high altitude. Some village folks believe that mosquitoes which bite them while they are cultivating in swamps cause malaria.

The Relationship between Malaria Incidence and Rainfall

It's by and large believed that rainfall increases the availability of mosquito breeding habitats, and thus the size of the mosquito population.

Figure 3 shows the two rain seasons experienced in Kabale; namely March to May and September to November. Although the malaria cases should rise and reach a peak at 1-2 months from the beginning of the rainy season, this does not appear to be the case as this study finds out. The likely reason is that there is gross under reporting of malaria cases in such way that only smear positive cases are reported. Yet all fevers are treated as malaria cases.

Figure 3. Monthly Rainfall trends in Kabale (1997-2005)



Malaria cases normally rise to a peak level 1 to 2 months from the beginning of a rainy season. However, Kabale's case seems to appear different. There are some months without rainfall yet malaria continues to escalate. It's observable that Kabale has of recent (2005 to 2006) become drier than before. Whether rainfall had an effect on the prevalence of malaria remains uncertain. There are paradoxical reports from the health workers. Some argue that most areas of Uganda have high malaria endemicity yet it does not rain through out the year. Mosquitoes are capable of flying for more than 1km. Even if the source of water was very far it could be accessed hence mosquitoes that bite an individual may have been produced 1-2km away. The commonest vector, *Anopheles gambiae*, is an efficient and effective vector. It breeds in little water masses such as that found left behind by a foot of a cow and broken containers, bananas and yam plantations that may be difficult to be seen by humans.

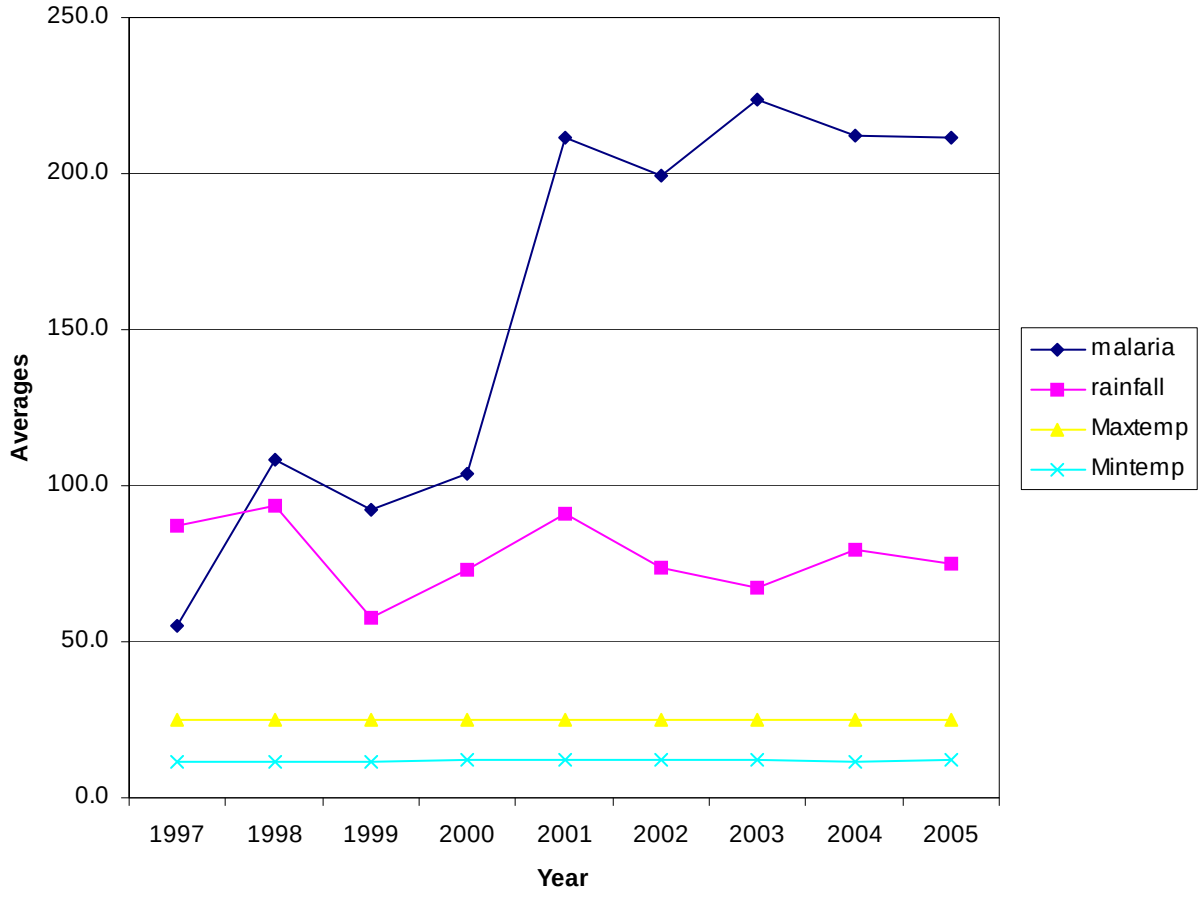
According to local communities in Kabale district, there was an epidemic in 1998 and 2002 and an upsurge of malaria cases in 2004. This however was not well reflected in our study. The possible reason was lack of proper documentation and absence of microscopes at all health centres to properly document all the cases hence gross under reporting. Nevertheless, during the time of this study, there were a few or no stagnant water bodies except in the valleys. Most of the hills were well terraced and no water collection areas were seen. On the other hand the valleys were full of stagnant water especially the swampy areas which could easily act as bleeding places for the mosquitoes

Relationship between Malaria, Temperature and Rainfall in Kabale District

Figure 4 shows the trends in average monthly minimum and maximum temperatures, rainfall and malaria over the years 1997-2005. This figure indicates a slight increase in both minimum and maximum temperatures; whether this is due to global warming is not

easy to conclude.

Fig. 4: The relationship between malaria, temperature and rainfall in Kabale (1997 – 2005)



Ministry of Health (National Malaria Control Programme) workers interviewed by this study gave contradicting answers. Some of them were able to say that temperature had influence on prevalence of malaria and others say no. It is difficult to get a clear correlation between the monthly average malaria cases and monthly average rainfall. However, malaria cases increased with the increase in both minimum and maximum temperature. Whether the increase in temperature is a result of global warming and or the environmental degradation such as drainage and opening up of swamps and cutting of trees as well as extensive cultivation is difficult to conclude. But, we can ably tell that the destruction of environment favour mosquitoes' population growth and increase in malaria parasites in the mosquitoes. This could in turn lead to increase in malaria prevalence.

Malaria outbreaks are sensitive to minimum temperatures. Analysis of trends in temperature data indicated that in the highlands of Kabale, there has been an increase of 1.17 ºC in mean annual minimum temperature between 1960 and 2001. During the 1997/98 El Niño, malaria admission data indicated that the epidemic months corresponded with the onset of abnormally frequent short rains, or that the El Niño years were preceded by a season of abnormally high maximum temperatures. This was confirmed with the observation of anomalies in the mean monthly temperatures

4.6 Conclusions

Malaria cases have increased over the years in Kabale district. There is a slight but stead increase in both minimum and maximum average monthly temperatures that correspond to an increase in prevalence of malaria cases.

It is still difficult to tell from this study or clearly determine the relationship between rainfall and malaria. Although mosquito populations increase with rain and malaria cases are expected to do the same. What appears important is the mosquito bleeding sites, which can be facilitated by rains. Another long-term scientific study is required to generate data on its own rather than dwelling on other sources, which are still inadequate.

SECTION III

5 Key Findings

About 10 million Ugandans are living in absolute poverty. Like all other poor countries in the world, Uganda is highly vulnerable to the impacts of climate change due to its low adaptive capacity. Agriculture and food security, health, energy, water, forestry and biodiversity sectors are likely to be seriously affected by global climate change.

The transmission of malaria has increased especially in the high altitude areas of the country and is currently the number one killer disease in the country. Recent epidemics of malaria have been observed in high altitude of Uganda, especially Kabale district. The disease appears to have increased in the 1990s reaching an epidemic level in 1998. Increased malaria incidence in Kabale district has been attributed to changes in land use patterns such as swamp reclamation but increases in temperature may also have played a role.

6 General Recommendations for adaptation

The government must address disease regimes that are largely associated with poor environmental conditions and ultimately poverty. Monitoring and intervention strategies are necessary to address increased incidence of disease associated with changes in temperature and rainfall.

There is a need to strengthen horizontal and vertical climate change information sharing networks among stakeholders. DENIVA should gather climate change related information and share it widely with various stakeholders including institutions of learning, government departments and community based associations. This is possible through NGO working group on climate change expeditiously formed to push for wider awareness and sensitization programmes. Civil Society Organisation /NGOs participation in climate change policymaking and implementation is crucial.

There is need for enhanced global cooperation more especially, for the fact that issues of climate transcend boundaries.

In rural livelihood systems malaria threatens food security, which is the critical adaptation challenge at local community level. The diversification of production activity, including off-farm income, drawing on local system, to draught is crucial to livelihood improvement.

Adaptation activities need to undertake a bottom-up approach to diversified development activities that is gendered; premised on ensuring equitable health service access; and recognizing that poverty alleviation requires health services that are based on secure and reliable supplies and stable prices. The empowerment of women in the public sector must received some attention as it remains a challenge to adaptation

A need for partnerships between public, private, civil society institutions for communication and public education on natural hazards, climate change and health. Informative health messages should be developed to provide the public with an understanding of potential health impacts of climate change and possible mitigation options.

Health risk scenarios should be developed periodically using the best available information on climate change anticipated in different ecosystems and on the potential health risks associated with such changes.

Popularization of best land-use and environment management practices to minimize conducive environs (including micro-climate) for air, water and vector-borne diseases incidence.

7 Research Recommendations

Research and capacity building need to be undertaken. Efforts should be made to enhance resilience to related risks through education, training, sharing of information on best practices, introduction of relevant technologies and management practices, and through strengthening of local institutional capacity. There is a need to develop a multi-institutional research network to better understand climate change and its health, social and economic consequences

There is a need to develop a multi-institutional research network to better understand climate change and its health, social and economic consequences. This further calls for partnerships between public, private, civil society institutions for communication and public education on natural hazards, climate change and health. Informative health messages should be developed to provide the public with an understanding of potential health impacts of climate change and possible mitigation options.

Another study that comprehensively takes into account the relationship of malaria prevalence and climate changes over time needs to be done. This should take more than 5 years to ensure comprehensiveness.

There is also a need for increased funding to support natural disaster health impacts research in Uganda.

8 References

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