

## PREPAREDNESS AND RESPONSE TO THE HEALTH IMPACTS OF CLIMATE CHANGE IN KENYA

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### ABSTRACT

Climate change is an environmental hazard, whose impacts is already evident and will transcend generations. Impacts of increasing climate variability on health are now evident with African countries at the greatest risk. This paper, undertakes a review approach to discuss climate change and health in Kenya, with emphasis on health risk preparedness. Recommendations are also made as suggestions for policy action

**KEYWORDS:** Climate change, Health, Disaster Risk & Kenya

### 1. INTRODUCTION

The world today is faced with global challenges, including environmental unsustainability, poor health and poverty, in general. The Sustainable Development Goals (SDGs) are geared towards protecting the planet, ending poverty, and enhancing peaceful and prosperous living. The SDGs philosophy is based on making the right choices today for sustainability across generations. These SDGs are threatened by increasing climate variability, Poverty, Poor healthcare, conflict among other factors.

In order to achieve sustainability, there must be an equal balance between social, economic and environmental pillars. Symptoms of a socially sustainable society include literacy, wealth, quality healthcare, peace and justice. An economically unsustainable society cannot support significant economic productivity sustainably.

Climate change impacts are already being observed, and are threats to the sustainability of communities and countries across the world. The Intergovernmental Panel on Climate Change (IPCC), in its fifth assessment report (Stocker, 2013) reveals that, impacts of increasing climate variability are now evident. The impacts include probability for more frequent and intense extreme weather events, disruption of infrastructure and livelihoods in coastal zones that are low lying, climate instigated conflict and migration, slower economic growth characterized by poverty exacerbation with a backlash in achieving SDGs alongside the 2030 envisioned Agenda.

The IPCC report, further indicates that countries with low incomes will be the most hit by the impacts of climate change due to their poverty. Lack of access to adequate sanitation facilities and water that is clean, Retrogressive cultural practices, Inadequate access to health care services, Disruption in food production systems and exposure to unclean energy sources are just but a few of the many factors that have been observed to increase the vulnerability of communities to increasing climate variability and change; where women are the most affected (Women, 2013). Climate change has multiple dimensions and impacts on food security (Schmidhuber & Tubiello, 2007); Health (patz *et al.*, 2005); Wheeler and Braun (2013) among others. Climate change impacts have potential to decelerate global development goals (Damtoft *et al.*, 2018) and consequently, the big four agenda.

At the mid of the next century, it is considered with high confidence that the following health impacts will be evidenced as a result of increasing climate variability namely: risk of disease, injury, death due to extreme weather events, enhanced bioactive radiation, floods and fires. It is also strongly considered that there will be increased risk of foodborne, vector borne, waterborne diseases and mal nutrition resultant from reduced food production due to extreme weather conditions (Watts *et al.*, 2015). These climate mediated health impacts are either direct, environmentally mediated or socially mediated impacts (Watts *et al.*, 2015). The direct impacts on human health are consequences of illness and damage from increased severity and frequency of events associated with extreme weather.

Impacts that are environmentally mediated include changing patterns of vector borne and water borne diseases, rising air pollution among others. Socially Mediated Effects (SME) is consequences of interactions of climate change with human and social systems.

Malnutrition; potential for population displacement and violent conflict; occupational heat stress and mental illness; Slowdown in economic growth and increasing poverty reduction are examples of SME (Watts *et al.*, 2015).

According to a systematic review by walker *et al.*, (2013); interventions have been employed to minimize vulnerability against health related risks among communities in Australia. They include health promotion, mental health and disaster planning, education and awareness, health equity, environmental change and behavioral change campaigns among others.

Many aspects of health are influenced by weather and climate conditions (UNECA, 2013). They include malnutrition, neglected tropical diseases, diarrhea, meningitis, malaria and dengue fever among others. Therefore, there is need to strengthen functions of health systems to enhance the resilience of communities to the impacts of increasing climate variability.

Children are highly vulnerable, owing to expected developmental and long term exposure exposure to hazards associated with changes in the environmental. Further, there is need to promote gender equity and public health approach in responding to climate change as provided for by the SDG as a strategy for climate and health action (WHO, 2003). The plan also reiterates the need for proper governance, collaborative and multi-institutional policy approach to enhance the resilience of communities against health impacts of climate change, with recommendation to include health into the National adaptation plan. Capacity building of health workforce; Resource input in public health infrastructure; institutionalization; integrated monitoring and early warning and communication systems; adoption of climate resilient technologies in the health sector; delivery of Services; climate sensitive health programming, proper management of determinants to environmental sustainability, and enhanced preparedness to emergencies and their management are key in vulnerability reduction (WHO, 2003).

A series of recommendations by UNECA (2013) to respond to climate mediated health impacts across African include but not limited to: Resource input in public health infrastructure; improvement in physical infrastructure; comprehensive drug therapy to combat and manage infectious diseases and improve mental health; increase in the number of clinics and health professionals; creation of platforms to share information, skills and technology between and within stakeholder in addition to improved regional modeling of climate change.

According to the policy brief by the United Nations Economic Commission for Africa (UNECA, 2013), African countries including Kenya are vulnerable to the health impacts of climate change. Kenya is already experiencing the

impacts of climate change (KNCCRS, 2010). KNCCRS recommends the following action plans in the health sector; in order to adopt to and mitigate health related impacts of climate change: Assessing the risks of populations to climate change including short and long-term public health effects utilizing climate-disease forecasting models, Identification of effective interventions; proper guidance to multisectorial health-promoting mitigation and adaptation decisions; Adequate research that supports decision support in matters associated to climate change and health; Benefit cost analysis of the health impacts of climate change; and application of Geographic Information Systems (GIS) in mapping spatial distribution of interacting risk factors and other data with proper and effective communication of research results effectively to policymakers, stakeholders and the public; promotion of empirical investigations on socioeconomic implications of climate change including climate migratory aspects of climate change that lead to high population densities in urban centers and likelihood of spreading infectious diseases; promotion of epidemiological and laboratory based research, infectious disease, ecology of all diseases that are likely to become more prevalent with climate change while and supporting institutions to engage in innovative research and vaccines production against diseases such as cholera, malaria, and others whose outbreaks will most likely intensify with increasing climate variability.

This study reviews advances in research carried out regarding the preparedness and response of public health to possible impacts of climate change in Kenya and provide information to stakeholders that can guide accelerated policy action.

## **2. REVIEW OF LITERATURE**

### **2.1. Climate Monitoring and Attribution**

Climate change monitoring utilizes ground based, satellite and atmospheric observations of environmental changes as well as using applicable data and models in forecasting changes in the climate system. Attribution is the process of scientifically ascertaining mechanisms responsible for changes in the climate system. Climate monitoring is a source of important information regarding the environment, including climate and weather conditions; extreme weather and climate events; annual and seasonal characteristics of weather and climate; air and sea surface temperatures, urban heat islands, precipitation, ice and snow characteristics; changes in phenology of important blossoms; El Niño/La Niña and PDO (Pacific Decadal Oscillation); Green House Gases (GHGs), aerosols and surface radiation; Ozone and Ultra Violet Radiation.

### **2.2. General Impacts of Climate Change**

A policy brief by the Kenya Government (KNCCRS, 2010) documents possible impacts of climate change, namely increase in desertification, submerging of land due to sea level rise and loss of biodiversity; altered spatial and temporal availability of fresh water; food insecurity due to crop failures and other risks; increase in infectious diseases including cholera, Malaria, plague, ebola, Lyme disease, sleeping sickness and tuberculosis, Rift Valley and yellow Fever are among diseases. Temperature and precipitation rise can lead to degradation of tourism activities due to disappearing beaches and unusual weather events; exacerbation in human-wildlife conflicts; changes of upwelling patterns, which might impact on fish spawning period and success of larvae, thereby altering the entire life cycle and size of fish population; disruption of food and energy supply systems; destruction of infrastructure including roads among others.

#### **2.1.1 Satellite Observations**

Global operational satellite agencies are important sources of satellite data, used in monitoring of the globe including

Kenya's weather, climate and environment in general. They include European Organization for the Exploitation of Meteorological Satellites (EUMETSAT); National Aeronautics and Space Administration (NASA) among others. Satellite data is archived in form of products by satellite observing instruments e.g. Moderate Resolution Imaging Spectroradiometer (MODIS). These products include radiances, aerosols, precipitation atmospheric profiles, land cover and many more. Readers are encouraged to visit individual satellite agencies to get more understanding of the available and ever improving products. In some cases, satellite and reanalysis data has been ensemble to give complimentary data products utilise the complementary nature of satellite and reanalysis data (Beck et al., 2017). Although Kenya successfully deployed its first nano satellite in Japan space on May 11, 2018; it majorly relies on global data sets archived by satellite agencies mainly in Europe and Japan.

## 2.2 Climate Change Adaptation and Mitigation

The Kenya National Climate Change Response Strategy (KNCCRS) defines Climate adaptation as, 'an adjustment in natural or human systems as a response mechanism to actual or expected climatic stimuli or their effects that can moderate, harm or exploit beneficial opportunities (NCCAP, 2013)'. The primary aim of adaptation is building resilience of communities against potential impacts of climate change while enabling people to adequately respond to climate risks towards a climate society, that is climate resilient. Actions to encourage GHG emissions that are lower than business-as-usual practice; and reduce the human causes of emissions by moving toward a resource efficient economy are deemed as mitigation. According to the Kenya National Climate Change Response Strategy (KNCCRS, 2010); Climate change adaptation actions in the health sector include recruitment of more (about 24,000) technical staff to strengthen public health services across the country; construction of a large number of nomadic clinics; health education campaigns and heightened surveillance of new outbreaks with consequent rapid responses. More information can be found in the policy document (KNCCRS, 2010).

## 2.3. Climate Risk Assessment and Public Health

A national vulnerability assessment of the climate risk and impact on sectors including health was recommended in 2010 (KNCCRS, 2010). An attempt has been made to assess the vulnerability of Kenyans to increasing climate variability by Oluoko-Odingo (2011); a study that focused only on food insecurity risk. A study by Opiyo and Wesonga (2014) assessed vulnerability of households to climate-induced stresses in Kenyan pastoral rangelands. In general, studies on health impacts of climate change are inadequate and call for more investigations. Studies by Onyango *et al.*, (2016) assessed vulnerability of East Africans to Malaria transmission and Climate Change focusing on biophysical influence on Malaria transmission. Promising findings can be noticed from this scientific study that raises the possibility of association of climate and some disease prevalence in Kenya. However, investigative studies on overall health risk to increasing climate variability, including risks for many potential deceases dependent on climate factors is still not adequate.

## 2.4. Climate and Disease Prediction Models

Climate projection models have been used to estimate past, present and future climate trends across the globe. General Circulation Models (GCMs) provide projection estimates of coarse resolution which is downscaled to fine scale climate scenarios by Regional Circulation Models (RCMs). A report of a study on future climate scenarios for Kenya's tea growing areas in 2011 indicated an increase in temperature over selected sites in Kenya by the year 2050 (Managua, 2011). A study by Juma *et al.*, (2016) indicated an increase of temperatures by 2.96 °C over Kenya by the year 2100 under business as usual scenario and perhaps warmer under worst case scenarios. However, the usage of climate disease prediction models is

still underscored.

## 2.5 Climate change impacts on Human Health

Human beings are vulnerable to impacts of climate change on health with differential severity depending on age, gender, individual behavior, economic status and ability of the public health systems to prepare and address the climate change mediated risks and their possible impacts (EPA, 2017; UNFCCC, 2017).

The impacts on human health will be characterized by compromised air quality; extreme weather events including floods and droughts; increased in increase in vector borne deceases and water related illnesses; Mental illness consequences; food insecurity and poor Nutrition with varying degree of exposure to climate related extremes (EPA, 2017). Frequent heat waves and hotter days will lead to health related deaths alongside increase in asthma attacks and respiratory health effects. wildfire creating smoke and other unhealthy air pollutants including nitrogen oxides, carbon monoxide and increase in airborne allergens, such as ragweed pollen; increase in harmful ground level ozone; adverse health effects related to poor quality air, including adverse health effects, bronchiectasis, lung cancer, Chronic Obstructive Pulmonary Diseases (COPDs), and cardiovascular diseases.

Extreme weather events can aggravate the health of humans especially children, poor, people with chronic illness, older populations and the disabled. Reduced availability of safe food and clean water can lead to food and water borne deceases and malnutrition while worsening mental health impacts such as depression and post-traumatic stress disorder. Communication and access to health facilities including utilization of health services may be interrupted by extreme weather events.

Changes in temperatures may activate many vectors including ticks, fleas, mosquitoes that will increase cases of transmission of pathogens to human beings. The pathogens include viruses, protozoa, and bacteria among others. Changes in bio-diversity in response to a changing climate leads to migration of tsetse flies and other decease causing agents to households where they will bite humans hence transmitting the pathogenic organisms. Water related illnesses associated with climate change include, increased exposure to waterborne pathogens including toxic algal and bacterial blooms; contaminated water bodies causing diarrheal infections.

Urban heat islands caused by climate change mediated migration to cities and other socio-economic factors may modify the climate of cities creating a conducive environment for disease causing agents (Patz et al., 2005). Further, change in temperatures associated with increasing climate variability may cause thermal discomfort, a phenomenon that may make human “feel ill” (Holmes et al., (2007). The thermal discomfort is projected to be more pronounced if the Physiological Equivalent Temperature (PET) is adopted instead of conventional air temperatures. Therefore, the health impacts of climate change have been underestimated (Matzarakis and Amelung, 2008).

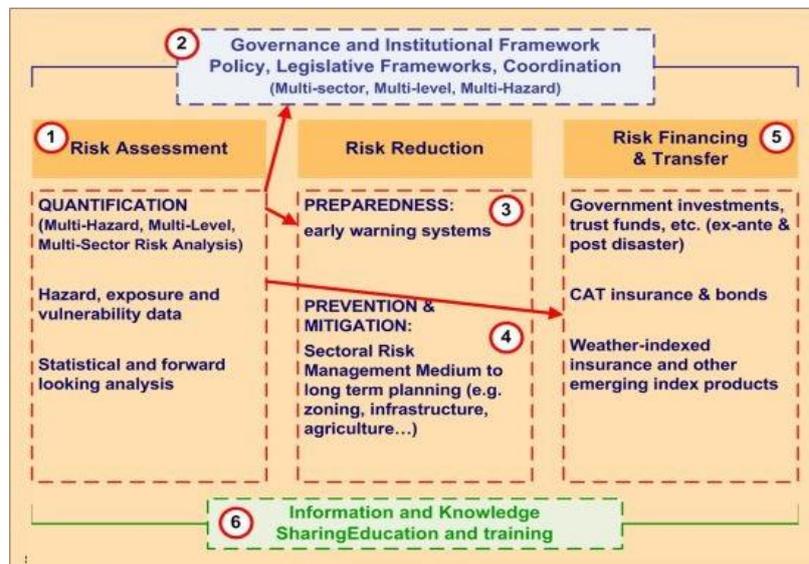
Githeko and Ndegwa (2001) attribute insurgent malaria cases in East Africa to permissive climate conditions. There has been evident of increasing climate variability over equatorial Kenya and Uganda (Ongoma and Omony, 2018). Changes in the ecology and epidemiology of vector borne deceases including malaria have been found to be dependent on biophysical drivers of the diseases in the western Kenya highlands that include climate change and variability, terrain, topography, hydrology and immunity (Githeko et al., 2012). El Niño, floods, Tsunami, drought, hunger climate related disasters observed in Kenya in the past among others (Awuori et al., 2008; GoK, 2009).

It is evident that rift valley fever outbreaks in Kenya occur after abnormally high rainfall, with more than three quarters occurring during the warm El Niño-Southern Oscillation [ENSO] period (Anyamba *et al.*, 2001). In a similar research finding, catastrophic malaria cases were observed in North Eastern Kenya during 1998, just after exceptional rainfall that had occurred between October-December in 1997 (Thomson and Indeje, 2003). Malaria cases have also been observed to be influenced by the Indian Ocean Dipole, a climate mode of coupled ocean-atmosphere variability, on East African rainfall including Kenya (Hashzume *et al.*, 2009). Another study by Hightower *et al.*, (2012) revealed that cases of rift valley fever fluctuated disproportionately with changes in annual rainfall over Kenya during 2006 and 2007 period. Cases of malnutrition attributable to climate change in Kenya have been identified in a study by Grace *et al.*, (2012). Therefore, there is increasing scientific evidence of the relationship between climate change and human health in Kenya.

**2.6. Public Health Preparedness and response to Climate Change in Kenya**

According to the Hyogo Framework for Action (HFA, 2005); five priority areas were identified as crucial for an integrated approach, from post-disaster response to include prevention and preparedness. They are efforts to make sure that reduction Disaster Risks (DR) is a national and a local priority with a strong implementable institutional basis; Identification, assessment and monitoring of DR and putting in place early warning systems; Usage of knowledge, innovation and education to build a strong resilient culture at all levels; Strengthening disaster preparedness for effective response at all levels; Reduction of the underlying risk factors.

Figure 1 below shows the interlink ages between the priority areas.



**Figure 1: Comprehensive Hyogo Framework for Action 2005-2015 Framework (Source: World Meteorological Organization DR Reduction Program).**

The Hyogo Framework for Action 2005-2015 is documented to have reduced DR at levels of engagement by countries and other relevant stakeholders, decreasing mortality in the case of some hazards and observed reduction of DR (HFA, 2005). However, there was need for people focus, their health, livelihoods, and regular follow-up of the HFA (SFDRR, 2015),

The Sendai Framework for Disaster Risk Reduction (SFDRR, 2015) outlines four priorities for action meant to

effectively reduce disaster risk and losses in lives, livelihoods and enhance quality health care in physical, Socio-economic, businesses, cultural and environmental assets of persons, communities and countries over the next 15 years. The priority targets identified in the Sendai Framework are drivers towards achievement of the priorities for action by 2030 and include:

Substantial reduction of global disaster mortality; reduction of direct disaster economic loss in relation to global gross domestic product (GDP); Meaningful increase in the number of countries with national and local disaster risk reduction strategies by 2020; substantial enhancement of international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of the present Framework and increase of the availability and access to multi-hazard early warning systems, disaster risk information and assessments to people; Significant reduction of the number of affected people globally; considerable reduction of disaster damage to critical infrastructure and basic services, including health and educational facilities through developing their resilience.

According to Gamper (2014), climate change is a disaster risk whose impact is expected to be felt by generations. In this regard, reducing the exposure of populations to the climate risk should start with risk assessments, which are basically a vulnerability assessment followed by establishment of strong, government supported institutional, policy and legal frameworks. Risk preparedness, prevention and mitigation enhance risk reduction which may be transferred to financiers, insurances and other relevant institutions. Accessibility of communities to relevant and shared information will accelerate the overall process of disaster risk reduction.

Kenya has demonstrated primary responsibility of preventing and reducing disaster risks, through global, regional, sub regional and bilateral cooperation. These collaborative interlinkages include, state member of the World Health Organization (WHO): Disasters and emergencies, United Nations Disaster Risk Reduction (UNDRR), United Nations Development Programme (UNDP): Disaster Reduction Unit respectively. Kenya has been able to enhance and implement DRR policies that include: National policy for disaster management in Kenya; Kenya climate smart agriculture implementation framework 2018-2027; Kenya climate smart agriculture strategy 2017-2026 and Kenya National disaster response plan.

The Country, in conjunction with International Monetary Fund (IMF) has also developed poverty reduction strategy paper (IMF, 2015) and presented official DRR statements in world conferences, including the third United Nations Conference on DRR in addition to developing relevant legislation including the National Disaster Management Authority Act (2019) that provides for the establishment of DRR authority with specific roles of operation and implementation at National, County and local levels, respectively. In this regard, DRR in Kenya is a shared responsibility between the central and county governments as guided by the Sendai Framework of DRR (SFDRR, 2015). All these actions undertaken by GoK are attempts geared towards protecting persons and their property, livelihoods, health, productive assets, cultural and environmental assets and promotion and protection of human rights. In general, the Kenya National DR reduction policy is guided by the provisions of the Sendai Framework (2015).

## **2.7. Health Sector in Kenya and the Big Four Agenda**

According to Sustainable Development Report (Assembly, 2015), ensuring healthy lives and promotion of well-being for all at all ages is SDG goal number 3, that strives to ensure everyone has health coverage, and access to safe and effective medicines and vaccines. This comes in the backdrop of the millennium development goals, whose impact culminated in the

decrease in preventable child deaths and maternal mortality. Other SDGs include expansion of manufacturing sector; affordable housing; affordable healthcare and food security which form Kenya's Big Four Agenda. The GoK has adopted a strategy to enhance health care affordability and access and with an aim of improving health outcomes by 100 percent universal health coverage (UHC) by the year 2022. This is intended to be realized by scaling up National Hospital Insurance Fund (NHIF) uptake; increasing the number of health facilities; employing adequate number of health personnel; procurement of relevant and satisfactory medical supplies and equipment. The GoK is on the path of legislation towards aligning NHIF and UHC while recruiting sampled drivers of this agenda from the Kenyan population, in addition to adopting new health care financing models. Maternal and child health care is expected to be enhanced through "Linda mama" programme and increased budgetary allocation to health from 7 percent in 2017 to 10 percent in 2022.

The Government had a proposal to introduce Robin-Hood taxes on selected services, whose proceeds would be directed to funding UHC programme, but faced legal challenges. This initiative would minimize tax burden to vulnerable communities.

The actions are intended to address capacity gaps, low staffing numbers, lower availability and access to health facilities as well as lack of essential equipment and medical products. Governance reforms and close strategic collaboration between the national and county levels of governments are paramount for the success of the in Kenya.

### **3. RECOMMENDATIONS AND CONCLUSION**

The Kenya Government has made attempts to enhance resource input in public health infrastructure with KShs 47.8 billion shillings estimated in 2019 budget, as part of the government's measures to avail quality health care services to Kenya. However, health is a devolved function with need for counties to prioritize health issues. In addition, improvement in physical infrastructure is critical if resilience of public health against impacts of climate change has to be addressed. Enhanced support for mobile clinics is also recommended as in the case of "beyond zero" mobile clinics initiative, but with an integrated focus including but not limited to maternal child health. The availability of mobile clinics aimed at minimizing maternal deaths is an indicator that a policy action towards accessible health care is implementable.

Comprehensive drug therapy to combat and manage infectious diseases and improve mental health is vital. Mental health cases have increased over the past prompting the World Health Organization to initiate "Comprehensive Mental Health Action Plan for 2013-2020" by member states including Kenya aimed at promoting mental well-being, providing care, preventing mental disorders, promoting human rights and reducing the mortality, enhancing recovery, morbidity and disability for persons with mental disorders (WHO, 2018). In this plan, actions of mental health significance include: socio-economic empowerment of women; early childhood interventions; programmes targeted at vulnerable people, including minorities, indigenous people, migrants and people affected by conflicts and disasters (including those from the impacts of increasing climate variability); social support for elderly populations; mental health promotional activities in schools; relevant housing policies for mentally challenged; mental health interventions at work; community development programmes; violence prevention programmes; poverty reduction and social protection for the poor; promotion of the rights, anti-discrimination laws and campaigns; opportunities and care of individuals with mental disorders among others. Counties have key role to implement these actions and only further research can reveal the extent to which the Kenyan County Governments have internalized and implemented this plans. There is an urgent need to train more mental health specialists in Kenya.

Capacity enhancement can address the need to increase the number of clinics and health professionals in Kenya, which currently has a nurse to patient ration of 1 to 2000 and with counties like Mandera, Turkana and Wajir having 83%, 76%, 61% below the national rate respectively (KNWR, 2012). There is a growing need to create public health knowledge management platforms, to enhance uptake and utilization of scientific knowledge related to public health (Mendez, 2003). In this regard, Kenya should take a multi urgency approach to support and initiate public health skills, technology and knowledge sharing platforms with emphasis on climate change and health. Kenya Climate change knowledge portal is one of such knowledge sharing platforms that require integration with health component. Investigative studies on overall health risk to increasing climate variability, including risk for many potential climate associated diseases are necessary. The need for improved modelling of climate has been addressed by scholars and research organizations, including Igad Climate Prediction and Applications Centre (ICPAC); Institute of Climate Change Adaptation of the University of Nairobi, Kenya Meteorological Department and the Climate Change Directorate, under the Ministry of Environment and Natural Resources (MENR); among others. However, this study finds the need to establish a Regional Climate Disease Prediction Centre (RCDPC).

RCDPC can be tasked through policy to assess the risks of populations to climate change, including short and long-term public health effects using climate-disease prediction models, and identifying the most effective interventions.

This study also finds the need for enhanced utilization of Geographic Information Systems (GIS) to spatially describe interacting risk factors and support of ideas, attitudes, technologies and innovation that lead to efficient sharing of research information to policymakers, stakeholders and the general public. Existing collaborative linkages to control emerging diseases and other climate related public health concerns should be expanded, to include all dimensions of climate change risk coordinated by a centralized interdisciplinary institutional framework.

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