

COUNTY GOVERNMENT OF MAKUENI



MINISTRY OF ENVIRONMENT, ENERGY AND NATURAL RESOURCES

## **MAKUENI COUNTY** CLIMATE INFORMATION SERVICES PLAN

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Government of Kenya Kenya Meteorological Department

#### Makueni County Climate Information Service Plan

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### Acronyms

Adaptation Consortium
Anglican Development Services – Eastern
Christian Aid
Arid and Semi-Arid Lands
County Climate Change Funds
Common Alert Protocol
County Climate Change Planning Committee
County Climate Information Centre
County Director of Meteorological Services
County Integrated Development Plan
Climate Information Services
County Meteorological Office
Coefficient of Variation
El Nino / Southern Oscillations
Famine Early Warning System Network
Global Framework for Climate Services
Makueni County Climate Information Services Plan
International Institute for Environment and Development
International Livestock Research Institute
Kenya Meteorological Department
Lamu Port-Southern Sudan and Ethiopia Transport corridor
March, April, May rainy season
National Climate Change Adaptation Plan
National Climate Change Response Strategy
National Drought Management Authority
October, November, December rainy season
Public Benefit Organisation
Radio and Internet (for the communication of hydro-meteorological and climate
information for development) FM Radio stations
Savings and Credit Cooperatives
Sustainable Development Goals
Strengthening Adaptation and Resilience to Climate Change in Kenya (Plus)
Training of Trainers
United Nation
United Nations Development Programme
Ward Climate Change Planning Committee
World Meteorological Organisation

### Foreword by the Director, Kenya Meteorological Department

The mandate of the Kenya Meteorological Department (KMD) is derived from the World Meteorological Organization (WMO) Convention, which is to provide accurate and timely weather and climate information and services for the safety of life, protection of property and conservation of the natural environment. Education and Training including research and development are additional functions designated by WMO to KMD. KMD's Vision is to be the leading a world-class Operational Forecasting Centre and Scientific Institution. This contribution is critical to the vision 2030 and the 4 agenda items that current government is focussing on.

The application of weather, climate and water information and related services helps to improve the safety and well-being of people, reducing poverty, increasing prosperity and protecting the environment for future generations. Meteorological Services activities are fundamental contributions to meeting the targets of the country's strategies such as Kenya's Vision 2030, the United Nation (UN) Sustainable Development Goals (SDGs), and the Johannesburg Plan of Implementation of The 2002 World Summit on Sustainable Development and relevant environment and climate-related conventions.

The Constitution of Kenya (CoK 2010) offers opportunity for services to be moved closer to the citizens at county and constituency or community/grass root levels. This opportunity, in turn, calls for a concerted effort by KMD to strengthen its infrastructure and services to reach and have the desired influence at the community or grass-root level of society; where the most severe impacts of climate variability and climate change are realized.

The Department needs to expand and decentralize its meteorological observation network as well as improve the dissemination of products and information. This includes setting up of County Climate Information Centres (CCIC) and sub-Counties offices to disseminate weather and climate information and advisories to the relevant agencies and communities, as these offices will be able to downscale the national forecasts for their areas of jurisdictions as part of the Disaster Risk Reduction strategy in line with Global Framework of Climate services (GFCS).

Climate change is a serious risk to poverty reduction initiatives and threatens to undo decades of development efforts. According to the Johannesburg Declaration on Sustainable Development, the adverse effects of climate change are already evident, natural disasters are more frequent and devastating, developing countries are more vulnerable. While climate change is a global phenomenon, its negative impacts are more severely felt by poor people and poor countries. They are more vulnerable because of their high dependence on natural resources, and their limited capacity to cope with climate variability and extremes. Moving the information centre closer will help in sensitizing the relevant communities in line with the Kenya Constitution 2010.

The potential benefits from enhancing the quality and use of meteorological, climate, and hydrological information and products in decision-making are enormous, but realizing these benefits will require improvement in infrastructure, human resources development, and engagement between the providers and users to improve the process for decision-making and realization of social and economic benefits. The CIS Plan is, therefore, a framework for providing these services at county level.

MR. PETER AMBERTE DIRECTOR - KENYA METEOROLOGICAL DEPARTMENT

### Foreword by, Makueni County Executive Committee Member

Climate change is one of the most serious global challenges of our time. The scientific evidence on effects of climate change is overwhelming, both at the global and local levels. Given the dependency of the communities on environmental and natural resources, economic growth and livelihood incomes of both urban and rural populations are highly vulnerable to climatic variability and change (EACCCP, 2011). Major indications of climate change effects in Makueni County have been temperature increases, rainfall irregularity and intensification, reduced food production, disruption of natural ecosystems and subsequent change and loss of habitats and species. This calls for the need to establish a functional County Climate Information Service.

The County Climate Information Service will play a crucial role in the county development planning, for managing development opportunities and risks and for mitigation and adaptation. Efficient application of climate services requires that there should be proper and efficient gathering and processing of weather information. Climate services include the dissemination of climate information to the public or a specific end-user. This requires strong partnerships among providers, such as governments, private sector, academia, communities and stakeholders for the purpose of interpreting and applying climate information for decision making, sustainable development, and improving climate information products, predictions, and outlooks. Timely communication of climate information helps prevent the economic setbacks and humanitarian disasters that can result from climate extremes and long term climate change.

Sustainable Development Goals (SDGs) enables nations and governments to institute various mechanisms and strategies to combat adverse effects of the ever worsening climate variability. County Climate Information Services will be used to provide guidance in planning and sustainable development in the county.

Promulgation of the Kenya Constitution 2010 ushered in a new governance system which also elevated issues of environment and development as human rights which effectively lays a firm foundation for establishment and effective management of Climate Information Services work. The system will be pivotal in providing a basis for strengthening and focusing countywide actions towards Climate Change adaptation and mitigation.

MR. ROBERT M. KISYULA THE EXECUTIVE COMMITTEE MEMBER WATER, IRRIGATION, NATURAL RESOURCES, ENVIRONMENT & CLIMATE CHANGE

### **EXECUTIVE** SUMMARY

Provision of easily accessible, timely and decision-relevant climate information can help society to cope with current climate variability and change; and in turn limit the economic and social damage caused by climate-related disasters. Climate Information Services (CIS) can also support society to build resilience to future climate change and take advantage of opportunities provided by favourable climate conditions. An effective CIS require adequate technical capacities and appropriate communication strategy that enables good exchange within information producers, translators, and user communities.

This initiative outlines a proposed framework for Makueni County Climate Information Services Plan (MCCISP) which aims to develop and deliver weather and climate information which can support local, sub-county and county-level decision making at time frames of hours, days, weeks, months, seasons and years in line with the county, national and international development frameworks including the County Integrated Development Plan (CIDP), Constitution of Kenya 2010, Kenya Vision 2030 and the National Climate Change Response Strategy (NCCRS) as well as the Global Framework for Climate Services (GFCS).

The plan recognizes that the delivery of Climate Information Service, which can effectively support decision making, requires the engagement of a wide range of stakeholders. Stakeholders of the MCCISP encompass: County Government Administration at county, sub-county, ward and village levels, County Ministry Departments across sectors together with their respective extension services, decentralized national Government agencies, religious leaders across different faith groups and denominations, local, community and livelihood associations, private sector bodies and national and international Public Benefit Organisations (PBOs) and universities and research institutions.

The plan aims to support development of an integrated framework for CIS which supports decision making across the principal livelihood groups as well as strategic and climate-sensitive sectoral county government planning. It comprises:

- Strengthening of Kenya Meteorological Department (KMD) observational capacities within Makueni county which will lead to improved quality of KMD products;
- Creating channels for two-way exchange of learning between the providers and users of weather and climate information through employing a variety of new and existing channels, including: a County Sectoral Planning Forum, community-based intermediaries, SMS and regional and local radios;
- > Developing a process for regular communication of daily, weekly, monthly and seasonal weather and climate information as well as extreme weather alerts and warnings which is accessible to the entire County population;
- > Providing weather and climate information which can support county level decision making, including strategy development, budgeting and planning across sectors;
- > Building the capacities of KMD and intermediaries to appropriately convey and employ weather and climate information within decision making processes at different levels and across time frames;
- > Assessing how local knowledge of weather and climate can support KMD to provide CIS which are better, and able to support specific livelihood decision making processes.

The MCCISP also includes a monitoring and evaluation system, encompassing a regular review after each principal growing season to identify ongoing constraints and observed benefits and ensure that ongoing-learning leads to revision and improvement for the subsequent rainy season.

The plan also seeks to ensure long-term sustainability through creating a reliable, user-led service which supports local, sub-county and county government decision making and explore how this can be supported by the introduction of demand-led, cost-recovery services.

This initiative once implemented will go a long way towards realizing the Kenya Vision 2030 in Makueni County and supporting the development of a community which is resilient to the adverse impacts of climate change, as envisioned in the National Climate Change Action Plan (NCCAP).

### 1. BACKGROUND AND CONTEXT

### 1.1 Background

Weather and climate has significant impacts on many aspects of people's lives and particularly amongst populations whose livelihoods are directly dependent on natural resources. Reliable climate information, including warnings and alerts on severe weather and extreme climate events, is important to support decision making for stakeholders including households, communities, subcounty and county levels. Information about longer term trends in climate variability and change is also vital to support major investments in infrastructure, including dams and roads, as well as conservation of the natural environment.

The mandate of Kenya Meteorological Department (KMD) is to provide meteorological, hydrological and related services in support of relevant national needs, including safety of life and protection of property, safeguarding the environment and contributing to sustainable development, as well as to meeting international commitments and contributing to international cooperation which is derived from the World Meteorological Organisation (WMO) Convention adopted on 11 October 1947 and revised in 2007.

#### KMD Vision:

#### A world class weather and climate service that contributes to sustainable development

#### KMD Mission:

## To provide our customers and stakeholders with prompt accurate and reliable weather and climate products and services for safety of lives protection of property and conservation of the environment

In line with the constitution of Kenya (2010), KMD has decentralised her services and in this regard established county meteorological offices. These sub-national meteorological offices will be expected to implement the mission of KMD at county level.

This County Information Service Plan (CISP) is a framework for development and delivery of climate information service in Makueni County. It was developed in consultation with stakeholders who included experts from across County Government Ministries and partner organizations, as well as community members in different livelihood zones. This CISP is a framework intended to support a range of measures for operationalization of KMD's Decentralisation Strategic Plan for provision of CIS action for Makueni county. There has been collaboration with senior representatives of County Government Ministries and other key stakeholders .

### 1.2 Roles and Responsibilities of County Meteorological Office

In line with the policies on devolution and decentralisation, KMD has established County Meteorological Offices (CMOs) in each of the 47 counties of Kenya. Established in 2012, the Makueni County Meteorological Office, is the sub-national weather service of KMD and is planned to be an information centre to reach the people of Makueni County with relevant weather and climate information.

Responsibilities of this Office include;

- > Monitoring weather, climate, water, air and noise pollution and related environmental information within the County;
- > Expansion and management of the meteorological observational network within the County;
- > Interpreting and implementing national policies on meteorology and climate change adaptation at the County level;
- > Downscaling of national weather forecasts and climate outlooks to the County level;
- > Issuing public warnings on hazards and extremes related to weather, climate and air pollution;
- Generating essential weather and climate information to support climate-sensitive sectors such as agriculture and food security, water resources, energy, transport, public health and sanitation, environmental conservation, disaster risk reduction, insurance, mining and tourism;
- > Building public awareness of the use of meteorological data;
- > Producing weather and climate information which can support the County's social and economic development;
- > Mainstreaming meteorological services in the development agenda of the County;
- > Promoting the use of local knowledge to build the resilience of communities in dealing with climate change extremes within the County; and
- > Mainstreaming gender, youth and people with disabilities in weather, climate and environmental governance in line with the Constitution.

### 1.3 Summary of Relevant Policies and Plans

The MCCISP recognizes that the delivery of Climate Information Service which effectively supports decision making requires the engagement of a wide range of stakeholders. Stakeholders of the MCCISP include; Government Administration at; County, Sub-county, ward and village levels, decentralized national government agencies, religious leaders across different faith groups and denominations, local, community and livelihood associations, private sector bodies and national and international Public Benefit Organisations (PBOs) and higher learning, Community Based Organizations and research institutions among others As such, the Makueni County Meteorological Office will develop and deliver the MCCISP through linkage with and supporting the activities of these stakeholder groups.

This CISP supports implementation of national and international climate change policies such as;

- 1. United Nations Framework on Climate Change Convention (UNFCCC)
- 2. Inter-governmental Panel on Climate Change (IPCC)
- 3. National Climate Change Response Strategy (NCCRS)
- 4. Global Framework on Climate Services (GFCS)
- 5. Climate Change Act, May 2016
- 6. National Climate Change Action Plan (NCCAP)
- 7. National Adaptation Plan (NAP)
- 8. Kenya's Vision 2030
- 9. Makueni County Vision 2025
- 10. Makueni county climate change fund regulation
- 11. Agriculture- climate smart strategy
- 12. Makueni county CIDP
- 13. Green economy strategy and implementation plan ministry of environment

### 1.4 Location and size

Makueni County is located in the arid and semi-arid regions, to the south eastern parts of the country. The County borders several counties which include; Kajiado to the West, Taita Taveta to the South, Kitui to the East and Machakos to the North. It lies between Latitude 1° 35′ and 3° 00 South and Longitude 37°10′ and 38° 30′ East (CIDP, 2013). The County covers an area of 8,034.7 Km2.



Figure 1: Makueni County Wards

### 1.5 Administrative and Economic characteristics of Makueni County

The County is divided into Six sub-counties namely: Makueni, Mbooni, Kaiti, Kibwezi East, Kibwezi West and Kilome.

The county has 30 Assembly Wards namely See Figure 1:

- 1. Mbooni sub county (Tulimani, Mbooni, Kithungo, Kisau/Kiteta, Kako/Waia, Kalawa wards)
- 2. Kilome sub county (Kiima Kiu/Kalanzoni, Mukaa, Kasikeu wards)
- 3. Kaiti sub county (Kee, Kilungu, Ilima, Ukia wards)
- 4. Makueni sub county (Nzaui/Kilili/Kalamba, Muvau, Kathonzweni, Mavindini, Kitise/Kithuki, Wote/Nziu, Mbitini wards)
- 5. Kibwezi West sub county (Makindu, Kikumbulyu North, Kikumbulyu South, Nguumo, Nguu/Masumba, Emali/Mulala wards)
- 6. Kibwezi East sub county (Masongaleni, Mtito Andei, Thange, Ivingoni wards)

#### 1.5.1 Population Density and Distribution

The County has six constituencies namely: Mbooni, Makueni, Kaiti, Kibwezi East, Kibwezi West and Kilome. There are thirty County Assembly Wards with Makueni Constituency having the largest number of wards at seven while Kilome has the least at three. The County is generally sparsely populated except in Kaiti and Mbooni constituencies which have Kilungu and Mbooni hills respectively.

Kibwezi East Constituency is the sparsely populated with 63 persons per Km2 mainly because it lies on the infertile lowlands characterised by annual insufficient rainfall of 351.9mm - 687.4mm. (CIDP, 2013). MAP OF COUNTY ADMIN BOUNDARIES UPTO SUB COUNTY





Figure 3 is a summary of demographic information for Makueni county based on the Kenya population census of the year 2009. High population is in urban centres while low population is in the rural areas. The low population in the rural areas is mainly attributed to, first the low and unreliable rainfall and second the occupation of most people who are mainly engaged in small scale agriculture.

#### 1.5.2 Demographic information for Makueni County

	Makueni
Area (Square km)	8,034.7 Km <sup>2</sup>
Population	922,183
House Holds	186478
Number of Males	430710
Number of Females	453817
Population Growth Rate	1.4

Table 1: Demographic Table of Makueni County Source: (GoK 2010)

### 1.6. Land and land use

The county has a total arable land of 5042.69Km<sup>2</sup> which is 74 percent of the total area. A total of 1,762.71Km<sup>2</sup> is non arable accounting for 21.9 percent of the total area. The County has potential in horticulture and dairy farming especially in the hilly parts of Kilungu and Mbooni west sub counties and also along the river Athi.

The lowlands are mainly used for livestock keeping, cotton and fruit production. The types of fruits grown are mainly mangoes, pawpaw and oranges. These areas include; Kathonzweni, Mbooni East, Nzaui and Makueni sub counties. The county has a mean holding size of 1.58 Ha.

Climate, vegetation and land use potential have been used to assess land suitability for different uses (Makueni County CIDP 2014). The major elements of climate that affect vegetation growth are the intensity and duration of rainfall; the relationship between annual rainfall and potential evapotranspiration; and the year-to-year variation in rainfall.

Kenya is divided into seven agro-climatic zones using a moisture index (Sombroek et al., 1982) based on annual rainfall expressed as a percentage of potential evaporation. Areas with an index greater than 50% have high potential for cropping, and are designated zones I, II, and III. These zones account for 12% of Kenya`s land area. The semi-humid to arid regions (zones IV,V,VI, and VII) where Makueni County is located, have indexes of less than 50% and a mean annual rainfall of less than 1100 mm. These zones are generally referred to as the Kenyan rangelands and account for 88% of the land area.

Agro – Climatic Zone	Classification	Moisture Index (%)	Annual Rainfall (mm)	Land Area (%)
1	Humid	>80	1100-2700	
П	Sub-humid	65 - 80	1000-1600	12
111	Semi-humid	50 - 65	800-1400	
	Semi-humid to semi-arid	40 - 50	600-1100	5
$\vee$	Semi-arid	25 - 40	450-900	15
$\vee$	Arid	15 - 25	300-550	22
VII	Very arid	<15	150-350	46

#### Moisture availability zones in Kenya with rainfall and proportion of land

Table 2: Table of Moisture Availability zones in Kenya with Rainfall and Proportion of Land Source: Sombroek et al. (1982).

The seven agro-climatic zones are each sub-divided according to mean annual temperature to identify areas suitable for growing each of Kenya's major food and cash crops. Most of the high potential land areas are located above 1200 m altitude and have mean annual temperatures of below 18° C, while 90% of the semi-arid and arid zones lies below 1260 m and has mean annual temperatures ranging from 22° C to 40° C. There are four inter-connected factors that determine the long-term availability of grazing resources in pastoral production systems: (i) variability in rainfall; (ii) the efficiency with which rainfall is converted into useable forage; (iii) the use of grazing resources by the domestic and wild herbivores; and (iv) the relationship between quantity and quality of the resources.



Figure 3: Makueni County Spatial Plan 2017-2027

Makueni county has four major agro-ecological zones namely UM4, LM4, LM5 and IL6. The larger part of the county lies under LM5 agro ecological zone comprising of Makueni, Kathonzweni Kibwezi West and Kilome sub counties. Kibwezi East is under IL6 while Mbooni and Kaiti lie in the UM4 agroecological zone.

### 1.7. Natural Resources

National resources in Makueni include forests, wildlife, minerals, river sand, land and rivers. Makueni County is endowed with diverse natural resource base; such as water sources , pasture,

woodlands, sand, forests, wildlife among others. These natural resources support the livelihoods of the populations, who are mainly sedentary agro-pastoralists. The main water sources include three major rivers: Athi river, Thwake, Kibwezi, Muooni, and Kaiti river. Of these, Athi is the only permanent river in the county. The others are seasonal rivers and quite useful to the communities. The County Government of Makueni has constructed several sand dams along the seasonal rivers.

Makueni hosts one of the major national parks in Kenya namely, Tsavo East and West National Park, Chyulu National reserve.The major national reserve is Makueni Ngai Ndethya national reserve. Makueni also hosts five major forest reserves namely; Nzaui Hill forest, Katende Hill Forest, Kyemundu Hill Forest, Yekanga hill, Kibwezi Forest, Nthangu, Kitondo, Kilungu, Mbooni, Makuli forest. These forests are very important for wood fuel source, water, pasture, honey, resins and are very important to pastoralists during dry season and also as breeding ground for birds and butterflies.

### 1.8. The Climate of Makueni County

The county has an arid to semi-arid climate with hot and dry days. The county receives rains twice a year, with the main rains season occurring in October-December and lesser rains season occurring in March-May (Barring, 1988). The October-December rains season often referred to as the short rains are more reliable for agricultural production in the area compared to the March -May often referred to as long rains. The annual rainfall ranges from 500 mm in the lowland areas to above 1100mm in the sub-humid hill tops (see Figure 6 below). The seasonal rainfall is highly variable, erratic and unreliable. The people are agro pastoralists and rely on peasant farming (Climate Change Network of Kenya, 2013). In the recent past, drought hazards have increased in frequency and complexity probably exacerbated by climate change. The level of devastation due to drought is becoming increasingly severe with loss of livelihoods.

### 1.8.1 Characteristics of Seasonal Rainfall in Makueni

Over the years, periods of high annual and seasonal rainfall followed by periods of very low annual and seasonal rainfall have been recorded in Makueni County. This has enabled the analysis of time series graphs of annual and seasonal variations of rainfall with remarkable comparison of the earlier years of the century and the recent years for purposes of identifying climate change. Rainfall is the most important climate element for rain fed agriculture production in arid and semi-arid areas. The annual rainfall pattern over for Makueni is characterized as bimodal (Musembi 1984, Ogallo 1981, Dennet et al 1982, Braun 1977, Jaetzold and Schmidt 1983) with tropical diurnal type of rainfall often received in the afternoon.



Figure 4: Spatial Distribution Map of Mean Annual Rainfall in Makueni KMD 2009

The October-November-December (OND) season receives relatively more rainfall than the March-April-May (MAM) season except for the lee ward side of hills in parts of Kilome subcounty. Recorded rainfall amounts for the OND season ranges between 100mm to over 7000mm. The month of November forms the peak period of rainfall for the season. KMD 2009 Figure 5 below show the mean monthly variation of seasonal rainfall in Mbooni stations in Makueni County.



Monthly Rainfall Climatology 1983-2014

Figure 5: Mean Monthly Rainfall in Makueni County and specific at Mbooni Forest Station

### 1.9 Economic Activities and Food Security

Sedentary agro-pastoralism small scale irrigation is the main source of income in the County. It accounts for seventy eight percent (78%) of the total household income, followed by wage employment at ten percent (10%), while rural and urban self-employment contribute eight (8%) and four per cent (4%) respectively. Due to the arid nature of the County, agriculture which is the main economic activity has been performing poorly. This situation has limited the sectors' capacity to create much needed job opportunities. The Mombasa-Nairobi highway has positively enhanced the income from trade. However, trade among other sources of income are limited which have led to over reliance on the poor performing agriculture. As a result, the poverty rates in the County have risen.

The main agricultural practices common in the County include:

- > Mixed farming food crops/cotton/mango and livestock with a population of 348,217 (40%)
- > Marginal mixed farming cotton and livestock with a population of 267,212 (30%)
- > Mixed farming coffee/dairy/irrigation with a population of 268,242 (30%)
- > There is a fruit processing plant at Kalamba near Wote town to process the fruits as well as a ginnery for cotton processing. This will go a long way in value addition



Some of crops grown in Makueni Mangoes, green grams, sorghum and millet and photo of fruit processing plant



Mango Value addition at Kalamba Fruit Processing Plant

### 2. FRAMEWORK FOR PROVISION OF CLIMATE SERVICES IN MAKUENI COUNTY

Framework For Provision of Climate Services in Makueni County

### 2.1 Goals and Objectives

The MCCISP aims to develop and deliver accessible, timely, relevant climate information which can support local, sub-county and county-level decision making processes for the benefit of community livelihoods and key economic sectors in Makueni county.

The specific objectives are to provide:

- i. Relevant location specific climate information (daily observed rainfall, weekly, monthly and seasonal rainfall forecasts) that supports community level livelihoods and county and subcounty level decision making processes,
- ii. Early warning and alerts of extreme weather and climate events; such as droughts and floods, for safety of life and optimization of weather and climate dependent natural resources,
- iii. Sector specific climate information (wind speed and direction, temperature, relative humidity, sunshine hours, radiation, normalised indices (e.g. NDVI, SPI, VCI etc) climatological summaries of weather parameters) for county level planning,
- iv. Relevant climate information to contribute to the development of sector specific advisories for short term and long term planning.

### 2.2 Principles of provision of CIS

The Climate Information Services (CIS) in Makueni County commenced in 2012 and has been received among the communities and people of Makueni with varying opinion depending on level of understanding (experience, literacy and perception).

This climate information service framework has been developed based on a set of guiding principles which recognise that effective CIS needs to:

- i. Provide reliable probabilistic climate information.
- ii. Be relevant to users' needs and gender-sensitive.
- iii. Be accessible.
- iv. Foster increased trust through developing two-way channels of communication for coproduction of weather and climate knowledge.
- v. Support increased understanding and communication of uncertainty in climate information and, strengthen appropriate use of probabilistic climate information.
- vi. Sustainable service affordable and consistence
- vii. High priority for the needs of climate-sensitive sectors
- viii. Better access and use of climate information by users
- ix. CISP will address needs three spatial scales: national, county and community
- x. Climate services must be operational and continuously updated (sustainability)
- xi. Climate information is primarily a public good and National County Governments will have a central role in the CISP
- xii. The CISP will encourage global, free and open exchange of climate-relevant data
- xiii. The CISP will facilitate and strengthen existing climate services
- xiv. The CISP will be built through partnerships

#### 2.2.1 Principle 1- High priority for the needs of climate sensitive sectors

Agriculture and food security: In an era of rapid population growth, food security remains a major concern. Agriculture is vulnerable not only to market fluctuations but also to climate variability and climate change and natural hazards. This example illustrates how climate services can improve delivery, and provides a set of actions that will improve uptake and use climate services in this sector.

**Disaster and risk reduction:** Most natural hazards are caused by weather and climate. This example illustrates how user-friendly climate services can help counties and communities build greater resilience against floods, droughts, storms and other hydro-meteorological hazards.

**Energy:** Energy systems are the engine of economic and social development. Energy generation and planning of operations are markedly affected by meteorological events and energy systems are increasingly exposed to the vagaries of weather and climate affecting both the availability and energy demand.

**Health:** Climate variability and climate change have important repercussions on public health. Temperature and rainfall conditions influence the spread of communicable diseases while extreme weather events cause injury and death. This example also illustrates how demand-driven climate services can empower the health community to save lives.

Water: Water is vital for life, but an over or under supply can threaten life, societies and economies. The amount and availability of water is strongly influenced by climate variability and change. As this example illustrates, seasonal climate outlooks and other climate services and products can greatly improve water supply management.

Forest Reserve Sector: Makueni forest cover is well over 10% but afforestation needs to be continued to cope with the degradation going on.

#### 2.2.2 Principle 2- Better access and use of climate information by users

There are two principal groups of CIS users, those with climate-sensitive livelihoods and government planners and decision makers: which will act as a repository of all climate related information. This will be coordinated by the directorate of environment, natural resources and climate change. Representatives of Government of Makueni County promised to support the initiative.

Community users: Community users find current KMD information to be too general and not relevant to their specific localities and livelihoods. Farmers and pastoralists have requested for information on the onset, geographic and temporal distribution and cessation of the rains, including frequency of extended dry spells, as well as high and low temperatures, high winds, hail and cloud cover. They want to receive seasonal forecasts with monthly and weekly updates, daily updates as well as alerts throughout the year.

Some farmers and those engaged in activities related to agriculture and livestock have requested daily updates throughout the year to plan for resource management such as pasture and water, harvesting, drying, storage and marketing, particularly given increased variability in rainfall. Community users have also asked for information about extreme weather events, including heavy

rains which may cause flash floods cutting off roads. Weather and climate can have particular impacts on women including in their roles as principal providers of care for vulnerable household members and duties to meet household water requirements, as well as in their farming and marketing roles. The specific climate information should address the needs of all the strata of the community needs including women and youth, marginalised and disadvantaged groups.

Representatives from NGO's, County and National Governments departments and agencies have welcomed weather and climate information about short (seasonal, monthly, weekly, daily and extreme weather events), long-term (beyond seasonal) timescales, climate change and variability to support short and long term strategic and sectorial planning, create climate awareness and timely sharing with the community members.

KMD has undertaken consultations with a wide range of users and is strengthening its data, observational, processing, analysis and communication capacities to best meet the range of user needs identified.

## 2.2.3 Principle 3- CISP will address needs in three spatial scales: National, County and Community

Community users currently receive information from regional and local radio stations. Agricultural extension services have information but only provide demand-led services, requiring that farmers themselves take the initiative to seek support from the extension services. Amongst planners and policymakers across county line ministries, decentralized authorities and non-governmental organizations access to weather and climate information is currently patchy, with some obtaining information from KMD, and others from NDMA monthly updates.

The MCCISP proposes employing a range of channels of communication to ensure that climate information can reach the range of users in understandable formats and through trusted channels. The channels established will need to ensure reach and relevance for the most marginalized.

## 2.2.4 Principle 4 - Climate services must be operational and continuously updated (sustainability)

Users have a key role in enabling KMD to develop and deliver CIS which best support specific decision making processes. Users understand the specific decisions which particular types of weather and climate information can support. Technical experts from across line ministries can advise on key thresholds which significantly impact the County's principal livelihood groups, including climate parameters for crop development, livestock and crop diseases and pests. Local communities have historical knowledge about past weather events which can have support where past historical datasets are sparse. Local observations of weather and climate and its impact will be of tremendous value in enabling KMD to deliver more locally accurate and relevant forecasts.

MCCISP provides a framework to support ongoing exchange of information between the providers and users of weather and climate information. KMD is also proposing to undertake a pilot study to systematically collate and assess local weather and climate knowledge to see how this can support improved CIS.

## 2.2.5 Principle 5 - Climate information is primarily a public good and National/County Governments will have a central role in the CISP

Many users do not fully appreciate the probabilistic nature of weather and climate information. It is essential to build users' understanding of the levels of confidence and uncertainty within weather and climate information if they are to make appropriate use of this. Failure to strengthen this understanding risks heightening mistrust where users perceive the information as wrong when the less likely event occurs and increasing vulnerability where information is misapplied. Resilience can be increased through strengthening capacities to make decisions with uncertain information.

KMD has recognized the need to build the communication capacities of its staff. It has initiated risk communication training for KMD County Directors and the current initiative encompasses further training both for KMD County Offices and CIS intermediaries.

- ) The CISP will encourage global, free and open exchange of climate-relevant data
- ) The CISP will facilitate and strengthen existing climate services
- ) The CISP will be built through partnerships

### 2.3 Existing and Planned CIS Initiatives and Projects

The planned Makueni CIS initiatives aims at developing and delivering weather and climate information which will support Local, Sub-County, County and National-level decision making (annex 3) at time frames of hours, days, weeks, months, seasons and years in line with National and International development frameworks including the Constitution of Kenya 2010, Kenya Vision 2030 and the National Climate Change Response Strategy (NCCRS) as well as the Global Framework for Climate Services (GFCS).

## 2.4 The Implementation of Kenya's Vision 2030 and Makueni County Vision 2025.

Kenya's Vision 2030 for Makueni encompasses a number of major infrastructure projects and social and economic initiatives designed to strengthen resilience and development. These include: National flagship projects; such as:

- > Standard Gauge Railway line and a highway to pass through Makueni County;
- > Construction of Konza Technology City in the County;
- > ASAL irrigation development projects e.g. Thwake Multipurpose Dam
- > Rural electrification;
- > Development of ICT infrastructure;
- > Construction of rural roads;
- > Modernization of the meteorological services programme, and
- > The Advertent Weather Modification Programme.(AWMP)

Interventions to enhance the resilience of the County population being undertaken across a wide range of Governmental and Non-Governmental partners include;

- > Rehabilitation, expansion and development of irrigation schemes along Athi River to increase agricultural production in the county for enhanced food security;
- > Promotion of drought resistant crops such as pigeon peas, cow peas, green grams, dolichos lablab.
- > Upscaling of outreach health services;
- > Enhancing maintenance and servicing of key community water facilities such as boreholes;
- > Enhancing sustainable environmental conservation to forestall environmental degradation;
- Promote productivity of livestock in the County through provision of artificial insemination, curbing of livestock diseases, provision water, market information systems, marketing infrastructure and extension services to the herders;
- > Enterprise development, cooperative development to improve access to credit;
- > Value addition through creating light industries; eg Kikima Milk processing plant.
- > Construction of the Makueni Abattoir at Kathonzweni sub county
- > Agricultural Training Centre (ATC) at Kwa-Kathoka
- > Agricultural show at Makindu

### 3. OBSERVATION AND DATA

Meteorological data is key in development of any climate information service. Weather and climate monitoring and observation networks are basic infrastructure necessary for generation of meteorological data. It is important for Makueni county meteorological office to establish /rehabilitate/revive adequate and serviceable weather and climate monitoring and observation stations, as shown in the maps below, in order to deliver effective and relevant CIS to inform decision making among climate dependent livelihoods in the County.

### 3.1 Weather Observations and Monitoring Network in Makueni County

The earliest weather and climate record in Makueni County dates back to 1904. Through the years a total of 122 rainfall and temperature stations have been established in Makueni County. (See annex 4). The data from these station can be accessed at KMD Headquarters.

The network has been shrinking with time due to various reasons, ranging from, abandonment, lack of inspection and maintenance, lack of community observers among other issues.

To solve these problems, KMD has developed a strategic approach for establishing adquate network of observation and monitoring of weather and climate in Makueni County by way of. automating its observatories sensitization and awareness creation building partnerships and recruitment of community climate monitors. (annex 5).



Kambi Mawe Meteorologiocal Station

### 3.2 Future Plans for Observations Network

#### 3.2.1 Inventory of equipment and meteorological infrastructure in Makueni.

An assessment of all meteorological infrastructure (KMD and non-KMD) in Makueni county has been done, and an inventory and status thereof established. (see annexes 4, 5 and 6).

In support of the existing meteorological infrastructure in Makueni County KMD plans to install synoptic stations, temperature stations, rain gauges, and seismic stations to provide optimised network for Makueni County as indicated in Figure 9 below.

This CISP captures the existing and planned meteorological installations for optimal service delivery In Makueni county. KMD plans to install the following weather observatories for Makueni county with equitable distribution, as indicated in figure 9 below, across strategic and remote locations to enable real-time measurement of specific weather phenomena, to capture heavy rainfall and strong winds:

- i. 6 automatic weather stations, one in each sub-county.
- ii. 6 temperature stations situated in Mutito Andei, Kilome, Mbooni/Kibwezi, Athi Kiaoni, Makindu and Makueni Central.
- iii. 7 automatic rain gauges, strategically placed to capture flash flood events and 120 rain gauges are planned to capture climatic variability in all the agroecological zones of Makueni county

It is envisaged that a number of community-managed rain gauges will be installed, with training to ensure a standard way of collating information (see further Annex 2). Efforts will be made to locate rain gauges accessible to Ward Administrators and Adaptation committees, and, where relevant, with water and electricity facilities.



Figure 6: Map of Planned Weather Observation Stations

In tandem with the assessment of current meteorological infrastructure within Makueni County, KMD is undertaking efforts on data discovery, rescue and digitalization. Where possible KMD will seek to enter into a memorunda of understanding with the existing observation data of stakeholders to strengthen KMD' historical data.

### 3.3 Maintenance Plan for Observations Network

Data quality is very important in processing data for analysis and forecasting. For this reason, KMD prescribes to WMO's standards, processes and procedures for meteorological equipment installation and maintenance to ensure data quality. Calibration of meteorological instruments will be performed in order to ensure high quality data.

### 3.4 Management of Non KMD Observations

Kenya Meteorological Department (KMD) recognizes the fact that there are many organizations with observation stations, but who are unknowingly making erroneous observations, particularly rainfall observations. Therefore, there is need to assist such organizations to standardize their observations.

KMD will build partnership with organizations and institutions and individuals for collaboration in weather and climate observations. Such collaboration will be done under the WMO integrated Global Observing System (WIGOS) framework, to ensure improved quality and availability of data and metadata, developing capacity (observation technical and maintenance), improve access to data.

### 3.5 Role of Community Climate Monitors

There is no national meteorological service in the world which has resources required to establish stations desired for delivery of service. Most of them rely on community climate monitors; who include individuals or institutions. This arrangement helps to supplement data acquisition to reasonable levels. Kenya Meteorological Department has this arrangement and will continue to encourage more local institutions and community at large to volunteer and manage observation networks in their respective areas. KMD will empower them through trainings and provision of equipment such as rain gauges. In turn, KMD will use the data to improve service delivery.

### 3.6 Data Discovery and Rescue

There is a lot of data sitting in databanks outside KMD. This data is still useful for inclusion in the development of climate information services. KMD and stakeholders in Makueni will try to get this data through Memoranda Of Understanding (MOUs) to ensure that it is archived in a format that can easily be accessed. This will enable establishment of data resource centre.

### 4. PROVISION OF CLIMATE INFORMATION SERVICES

The Makueni County Meteorological Office will develop weather and climate information which supports decision making across the principal livelihood groups as well as strategic and sectorial county and national government planning. The County has good records of historical rainfall data dating from 1940 to date. The availability of hydro-meteorological data. is very important for Makueni County Meteorological Office for effective delivery of CIS.

### 4.1 Weather Forecasts and Climate Prediction Products

Weather and climate products are generated at different levels i.e. Global, regional, national and downscaled to county and community levels. These national level forecast are released to CMO as need be for use at County level. The CMO has a role of downscaling the national level products to local scales in order to address local level needs. Weather and Climate products at Makueni CMO include: probabilistic weather forecasts ranging from short term (daily, weekly), medium range (monthly and seasonal) and long term (beyond a seasonal), rainfall onset, cessation and distribution and climate summaries and normals. The CMO uses historical climate data and local knowledge of climate variability to downscale the national monthly and seasonal forecasts to develop a forecast for Makueni County. This downscaled is further domesticated to reflect and be relevant to specific areas up to ward level.

### 4.2 Development of Weather and Climate Product

The products indicated in this CISP will be developed following identified stakeholder needs in Makueni county, Climate change scenarios are available at KMD headquarters and can be downscaled to county level. The CMO will provide:

- Seasonal, monthly, seven day, five day and daily forecasts, as well as summary versions for SMS transmission.
- > The seasonal forecasts will be combined with sectorial expertise to provide livelihood advisories.
- > Warnings of unusual or extreme weather events for transmission via national and county administration, departments and agencies and a full range of intermediary and media channels.
- Weather and climate data, summaries and normals (these summaries include total rainfall amount and distribution in a particular period, maximum and minimum temperatures ,wind speed and direction, sunshine hours and relative humidity distribution in a Makueni County). These products are useful to specific county and national governments agencies, NGO's and the community at large for planning for climate sensitive activates activities.
- Climate change projections and scenarios. These products are important to support medium term and long term planning. The timeframe and content of CIS products are outlined in Annex8.

### 4.3 Downscaled Forecasts

Downscaling weather/climate forecast involves reducing weather/climate information known at large scale (regional/national) and present the same for local scales.

These downscaled products indicate locally relevant variability and details which have effect at local level. The county meteorological office has the responsibility to downscale all the nationally generated products to local scale.

Interpolated and gridded historical climate rainfall data retrieved from both KMD and private observatory archives combined with satellite based rainfall estimates and local knowledge of climate variability will be used to down-scale the national forecasts to develop a forecast for Makueni County. However, the downscaled weather forecasts for the County will become more accurate as a result of the placing of new recording equipment in several other parts of the county.

Makueni Meteorological office will be employing the most current down-scaling tools recommended by both KMD and WMO to produce down-scaled monthly and seasonal predictions for the County. Both monthly and seasonal forecasts will be issued in a discrete and tercile formats.

### 4.4 Approaches to Making Information Locally Relevant

Relevance may be achieved by identifying local scale climate variations with features or locally measured climate parameters. In Makueni county relevance of climate information as provided in this CISP will be achieved by establishing climate measurements at local scales (community level), provision of climate information in understandable language and capacity development. indigenous and local knowledge existing among communities will be incorporated in generating and reporting climate information for purposes of local relevance.

### 4.5 Technical Downscaling

Three technical approaches will be followed for purposes of creating relevance in climate information. First, weather and climate parameters measured at local level will ensure that communities have ownership of the information. Towards this objective weather instruments as indicated above will be installed. in collaboration with local communities who will identify community climate Monitors (CCM).

Secondly, this CISp will seek to improve knowledge of the local factors affecting the climate of Makueni county. In this regard, the CMO will seek ways of integrating conventional and scientific methods and the indigenous knowledge from among the communities for purpose of relevance of climate information.

Thirdly, Consistent with the principle of building trust this CISP will endeavor to create relevance of the climate information through developing two-way channels for communication and co-production of weather and climate information together with stakeholders. The CMO will initiate a pilot study to identify how local knowledge may support communication of KMD forecasts.

### 4.6 Presentation and Language

Makueni County meteorological office will be issuing weather and climate information in English and Kiswahili. However, where necessary, the information will be translated into the local language (Kikamba), to increase understanding and uptake of information among communities. This information will be packaged according to the targeted audience. Interpretation of meteorological terms into local languages in form of a dictionary (English/Kikamba), will be done to further improve understanding of climate information. Attempts will be made to have appropriate presentations for people with disabilities (braille for the blind, sign language for the deaf)

### 4.7 Description of Weather and Climate Products

Reliable daily, weekly, monthly and seasonal information, as well as warnings and alerts on extreme weather events will be developed to support decision making among society and community. Information about climate variability, trends and change which is vital to support major investments in infrastructure, including dams and roads, as well as conservation of the natural environment will be developed.

### 4.7.1 Forecast Products

Weather forecast and Climate prediction products are statements of future weather/climate conditions issued for different time scales ranging from hours, days, weeks, months to seasons. Forecast products are based on conditions that are known at present and assumptions about the physical processes that determine the future state in weather and climate. Several scales of climate and weather products are issued by KMD and also available at Makueni CMO. These products are seasonal, monthly weekly and daily forecasts of weather and climate.

### 4.7.2 The Seasonal Forecast

Seasonal forecast is a three months rainfall outlook usually developed on a regular basis by KMD headquarters in Nairobi. The seasonal climate outlook depicts the amount and distribution of rainfall patterns for two major rainfall seasons in Makueni county (MAM and OND). The seasonal forecast also has indications of onset and cessation dates of the rain season. The forecast is issued at least one month ahead of the start of the season. The forecast is issued based on tercile probabilities of occurrence of the normative rainfall. The seasonal forecast will be downscaled from national scale to capture local climate feature for purposes of relevance use at community level.

### 4.7.3 Monthly Forecast

The monthly forecast is climate outlook depicting the amount and distribution of rainfall patterns within the month. The forecast is issued every end of the month to give indication of the climate outlook of the coming month. The forecast is indicated in tercile categories of characteristics of seasonal rainfall such as 'above normal' to mean enhanced amounts of rainfall, 'normal' to mean rainfall amounts close to average and 'below normal' to indicate rainfall amounts of depressed rainfall.

#### 4.7.4 Weekly Forecast

The weekly forecast depicting the amount and distribution of rainfall patterns within the week. The forecast is issued every Monday of the week to give indication of weather conditions in the coming week.

### 4.7.5 Daily Forecast

Daily forecast is an indication of weather conditions expected in the next 24hrs for a particular area.

### 4.8 Early Warning and Alerts

Early warnings and alerts are statements issued by meteorological service on weather and climate hazards. These are issued for purposes of disaster risk reduction to enable prevention of loss of life and destruction of property and, economic losses and environmental degradation from weather/climate hazards. When and where necessary, KMD will issue early warning and alerts on expected hazards. MD will follow standard operations procedures (SOPs) in indicating the level of danger from the hazard. The Makueni CMO will maintain a close and continued link of early warning and alert information from KMD headquarters for purpose of advice on eminent weather/climate hazards in Makueni County. Specific severe weather and extreme climate events often experienced in Makueni include drought, high wind, dust storms, flash-floods among others.

### 4.9 Climatological Normals and Trends

Climatological Normals are averages of climatological elements (temperature rainfall wind sunshine radiation cloudiness,) over specified long term periods of 30years (rolling decadal thirty year periods e.g. 1961-1990; 1971-2000.1981-2010) and location. Climatological trends are temporal indications of long term changes of the averages of the climatological elements.

Climatological normal and trends are useful for two major purposes:

- 1. Benchmark or reference against which climate conditions (especially current or recent conditions) can be assessed; and
- 2. They are widely used (implicitly or explicitly) as an indicator of the conditions likely to be experienced in a given location

The CMO will generate climatological normals and trends for relevant climate elements for specific locations in Makueni County. These normals and trends will be used to inform the development programmes in the county as stipulated in the CIDP.

### **4.10** Climate Change Projections

Climate change projections are scenarios of future climate based on a hierarchy (scales and complexities) of model types, ranging from Ocean-Atmosphere General Circulation Models (OGCMs) and Earth System Models of Intermediate Complexity (EMICs) to Simple Climate Models (SCMs). These models are forced with storyline/pathways of emission concentrations of greenhouse gases and other constituents.

Climate Change scenarios offer ways of identifying and examining challenges posed by climate change.

Selecting projections for Makueni County requires careful consideration of the natural resources of the county, and how they are sensitive to climate. Downscaling climate projections increases the spatial resolution of climate information and makes projections more relevant to natural resource managers by allowing decision-makers to better visualize what these different scenarios imply to the county.

For Makueni, CMO will develop downscaled scenario projections for relevant climate elements (Rainfall and Temperature, ) at different time spans (decadal, quarter century, half century, century) to support medium and long visionary planning (e.g CIDP, County Visions). The annex 8, shows a range of products that will be generated for sectoral experts to support planning.

# 5. COMMUNICATION AND DISSEMINATION OF CLIMATE INFORMATION SERVICES

Climate information as an important factor in decision making needs to be communicated efficiently and effectively. KMD undertook an assessment of user climate information needs including channels of communication and dissemination. Key issues among the findings include the need to establish a Makueni County Climate Information Centre at Wote town to act as a one-stop shop for stake holders who may wish to make weather related interventions Following the identification of user needs a communication strategy has been developed. This section presents the communication strategy to be used in MCCISP. This strategy, recognizes that there are different levels of users who require different platforms of communication and also emphasizing on the two-way (feedback/feedforward) communication approach. Several channels and platforms have been identified for use in this strategy. Electronic media, Print media, ICT, Intermediaries, county climate outlook fora/workshops (CCOF), concert, dances and songs, and barazas. In this strategy, efforts will be made to develop a weather/climate dictionary in the local languages for easy of understanding of climate information among the communities. Efforts will be made to improve capacity of communities to uptake CIS.

### 5.1 Electronic Media

Traditionally, Kenyans listen to radio and watch TVs most of the time. Local FM radio stations have been identified among the local communities as having the most reach. Disseminating CIS in this media is expected to reach many people. This is especially important for short and medium term forecasts. The communication strategy in the MCCISP, will greatly depend on the use of traditional electronic media (radio , TV,). Electronic media is best suited for summary CIS statements which are intended to give guidance on general decision making. Use of local regional TV stations like kyeni Tv.

### 5.2 Print Media

Print media comprises of newspapers, fliers, brochures, bulletins, posters and magazines. This media has an advantage over all others because it does not limit the quantity of content to be communicated. This makes it better for communicating short and medium term CIS and advisories for decision making. It acts as reference material and can easily be used in validation

### 5.3 Information Communication Technology (ICT) Platforms

In the recent times ICT has been developed to the level that it has become prominent and important tool for development in Kenya. In this strategy, ICT includes communication through cellular phones, internet, email, websites, satellite systems, video conferencing among others. In this MCCISP, ICT will be used for availing climate information at both communities and government levels in Makueni county. The channel will focus on the youth who form the majority of the population and also have affinity of ICT. Email, internet (Websites) and Video conferencing will be used for official

communication at county and subcounty levels, These platforms have capacity to carry detailed analysis of climate information and is also favoured for easy access and low cost.

Mobile phones have taken prominence among society and communities in the recent days. Mobile phones have been widely accepted and used as way of effective communication enabling development at grassroot levels. They have features which enable mass communication of climate information on different platforms, e.g bulk SMS, social media, among others. These platforms will be used to communicate the following types of climate information products;

- > Highlights of the seasonal forecast
- > Monthly and weekly updates
- > Daily updates; daily forecast, observations
- > Alerts and warning of hazardous weather.

### 5.4 CIS Intermediaries

This communication strategy envisages collaboration with respected and influential persons among communities for purposes of delivery of climate information to the grassroots. KMD in collaboration with other stakeholders will identify among the communities intermediaries who are persons prepared to receive weather and climate information and share the same through their existing networks and partners. The process of identifying the intermediaries in Makueni county will take into account the distribution of the population and gender in order to have equitable representations of climate information among all communities. Through this approach, relevant local scale climate information will reach the furthest end of the society.

### 5.5 County Climate Outlook Fora/Workshops (CCOF)

The use of expert information among the communities require continued consultation and collaboration of multi-stakeholders' users of information. This collaboration will be attained by creation of county climate outlook forums (in some cases it is called participatory scenario planning workshops (PSP)). The CMO Makueni will work with other government departments and key stakeholders to constitute members of these fora. This forum will be used for purposes of discussing downscaled seasonal forecasts and related local impacts and development of advisories to address those impacts. This forum will provide the opportunity for two way learning (feedback/feed forward) among users and providers of probabilistic climate information.

### 5.6 Building Capacity of Communities

It is recognized that effective use of CIS is a process which requires supporting the wide range of stakeholders to access, understand and appropriately apply climate information within specific decision making processes across timescales. Towards this objective the Makueni County Meteorological Office will organise programmes of awareness creation and sensitisation of communities. Towards this objective Makueni county and others will organize a project on building resilience.

### 6. PLANNING AND BUDGETING

The planning and budgeting (see annex 1 and annex 2) for this CIS Plan is based on the KMD's Decentralization plan five objectives covered in chapter one of this document:, namely:

- > To strengthen meteorological infrastructure (observation; data collection and exchange; processing, archival and product development; product dissemination) and capability to avail quality county and community level weather and climate services;
- > To contribute to the enhancement of County and Community level adaptation, and mitigation to impacts of climate variability and change for community livelihood resilience and sustainable development.
- > To develop capacity of Climate Information intermediaries to provide county/community level weather and climate information services for effective uptake of climate information.
- > To strengthen county and community based collaborative research to inform development of resilience community livelihoods.
- > To enhance integrated planning framework in order to improve service delivery and customer satisfaction.

The responsibility of funding CIS Plan budget and creation of enabling environment rests on the shoulders of National Government Ministries and agencies, County Government and its Departments, and other stakeholders-NGO's, Development partners and CBO's (see annex 1).

Establishing a Meteorological service is an expensive affair because it involves procurement of many items which are not readily available locally. Establishment of meteorological service requires:

- 1. Meteorological infrastructure (observation, communication, data processing and product development, dissemination, office space. Maintenance etc
- 2. Human Resource (technical staff, capacity building,)
- 3. Research and Development
- 4. Office Establishment (furniture, transport, Mobility)

### 7. MONITORING, EVALUATION AND REPORTING

### 7.1 Monitoring Approach

The framework for monitoring of the MCCISP will include appropriate indicators included in annex six coverage of the indicators included in and will consider progress in supporting climate-related decision support at local, sub-county and county levels across the plan period.

Those partnering in the implementation of the MCCISP will develop baselines (see table 1) of current access to relevance and use of existing climate information services. This will serve as a basis from which to track progress in efforts to strengthen CIS provision and support the development of a CIS communication plan which will work through established systems of trust, ongoing related activities of relevant ministries and NGO partners, and existing coverage of regional and local radio stations and mobile phone networks.

Monitoring tools will be developed and used to conduct monitoring on a continuous basis and address deviation.

### 7.2 Evaluation Approach

Periodic assessment of activities / achievement will be necessary particularly in relation to realisation of objectives and outcomes outlined in the plan. The CIS implementation will adopt a three stage evaluation structure to ensure that operational plans are geared towards targets set out in this plan. The evaluation plan will be as follows:

#### Table 3: Evaluation Stages of MCCISP (2018 -2022)

Evaluation stage	Calendar
Inception	To be undertaken at beginning of the plan period
Mid-term 2020	To be undertaken within the third year of the plan period
End term 2022	To be undertaken at the end of the Fifth year

Where evaluation reports highlight deviations, KMD and stakeholders as manager of these process are expected to take corrective action and timely intervention.

### 7.3 Reporting

The CMO will undertake seasonal post-seasonal reviews to assess progress and make the revisions required to develop accessible, timely decision-relevant CIS for Makueni County. It is proposed that the County Meteorological Office in collaboration with County stakeholders will provide an annual report reviewing progress in the implementation of the MCCISP to KMD Head Office, as well as all County Ministries and decentralized national authorities, and this report will be taken to an existing County forum for discussion across key Ministries and MCCISP stakeholders.

### 8. ANNEXES

#### Annex 1: Planned CIS implementation matrix

Strategic Strengthen meteorological infrastructure (observation; data collection and exchange; processing, archival and product development; Objective 1: product dissemination) and capability to avail quality county and community level weather and climate services

Strategy	Activity	Output	Indicator	Target for five	Time frame				Budget (Kshs.	Responsibility	
				years	Yr1	Yr2	Yr3	Yr4	Yr5	M)	
Establish	Construct observatories; at Konza City,Makindu, Kibwezi, Athi Kiaoni Mbooni and Wote, Acquire and Install instruments;	Operational met stations.	No. of Synoptic stations	2	0	0	1	1	0	100.00	Director & CDM
	Acquire and Install AWS at least 2 per Sub-County	Weather data	No. of AWS	6	1	2	2	3	2	30.33	Director & CDM
weather and climate services	Acquire and Install Automatic rain gauges at least 2 per ward	rainfall data	No. of Automatic rain gauges	20	2	4	4	6	4	6.00	CDM
infrastructure	Acquire and Install Manual Rain gauges at least 10 per ward	Rainfall data	No. of Manual Rain gauges	100	10	20	20	30	20	3.50	CDM
	Acquire and Install Weather radars receiver at th ecounty headquarters	Weather data	No. of Weather radars receiver terminals	1	0	0	0	0	1	1.00	Director & CDM

	Acquire and Install pollution monitoring equipment at Wote town	Pollution data	No. Of pollution monitoring equipment	1	2	1	0	10	1	7.49	Director & CDM
	Acquire and Install Thermal stations	Temperature data	No. of Thermal station	6	1	2	2	1	0	4.20	Director & CDM
	Acquire and Install automatic hydromet station in Athi river basin	Hydrometeorological data	No. of stations	2	0	1	0	1	0	5.00	Director & CDM
	Instrument Inspections and calibration cost	Calibrated Instruments	No. of Instruments Calibrated	42	4	10	10	10	6	10.0	CDM
			No. of inspection trips	20	4	4	4	4	4		CDM
	Acquire and Install Satellite ground receivers	Satellite data received	No. of Satellite Ground receiving stations	1	0	0	0	1	0	34.26	Director & CDM
	Acquire and Install Database management system at the base station	Data processed and archived	No. of Database management system	1	1	0	0	0	0	4.00	Director & CDM
	Acquire mobile data collection tools (mobile phones)	data from community observers Collected	No. of Data collection tools	100	20	20	20	20	20	0.30	Director & CDM
Data collection and exchange infrastructure	Communication software (frontline SMS etc, )	Communication between Mobile data collectors & County AMSS enabled	No. of software	1	1	0	0	0	0	1.00	Director & CDM
	Acquire Data collection workstation (for data exchange) to collect and disseminate rainfall data from CCMs	data from community observers received	No. of Data collection workstation	1	0	0	0	0	0	0.10	Director & CDM

	Acquire High speed Internet connection for county offices	Access to data at national, regional & international centres	No. of High speed Internet connection	1	1		0	0	0	0.75	Director & CDM
	information telecommunication exchange system	Forward & feedback data between HQ and counties	No. of information telecommunication exchange system	1	1	0	0	0	0	0.10	Director & CDM
	Acquire Video/ skype Teleconferencing facilities for county offices	Enable simultaneous weather forecast conferencing and update from all regions of Kenya	No. of Video Tele- conferencing facilities	1	0	0	1	0	0	0.10	Director & CDM
	Acquire rapid response telecom for county offices (hotlines)	Rapid response to warning of rapid moving hazards (floods etc) before they cause harm.	No. of hotlines	1	0	0	0	1	0	0.05	Director & CDM
Processing, Product development and archival infrastructure	Acquire Forecast Interpretation Tools (software)	Downscale global, regional & national scale forecasts to county and community scale	No. of Forecast Interpretation Tools	5	5	0	0	0	0	1.00	Director & CDM
	Acquire Forecaster Work Station to link with NMC Forecastor work station	Improved capacity for rapid development of county and community scale climate information	No. of Forecaster Work Station	1	1	0	0	0	0	1.00	Director & CDM
	Acquire Licensed Geographical Information Systems (GIS) software	Precision of positioning of county and community level information	No. of Geographical Information Systems (GIS)	1	0	0	0	0	0	0.01	Director & CDM

	Develop a Web page hosted on KMS website	Enable online uptake of county level information	No. of Web pages	1	1	0	0	0	0	0.01	Director & CDM
	Develop Information Education Communication materials	awareness creation	No. IEC materials	10	1	2	3	3	1	0.10	Director & CDM
uptake of product and services	Maintenance cost for FM Radio transmission stations	Disseminate widely sector/livelihood information	No. of Radio	1	1	0	0	0	0	10.00	CDM
infrastructure	Public Display systems at Wotei town	reach public with climate information	No. of Public Display systems	1	1	0	0	0	0	0.10	CDM
	Exhibition display systems (LCD Beamer)	Effective outreach and demonstration of potentials in climate information (conference, video teleconference, boardrooms etc.)	No. of Exhibition display systems (LCD Beamer)	1	1	0	0	0	0	4.0	CDM
Zotal Budget in Kshs. M										211.38	

### Annex 2: Budget Summary

Thematic Area	MAKUENI	Total							
	Financial Year (ir	Financial Year (in Kshs. 221.38M)							
	2016/17	2017/18	2018/19	2019/20	2020/21				
Establish county level weather and climate services infrastructure	20.29	63.09	65.65	47.60	10.14	206.77			
Data collection and exchange infrastructure	1.91	0.06	0.16	0.11	0.06	2.30			
Processing, Product development and archival infrastructure	2.00	0.00	0.00	0.00	0.00	2.00			
uptake of product and services infrastructure	10.22	0.02	0.03	0.03	0.01	10.31			
Total	34.42	63.17	65.84	47.74	10.21	221.38			

### Annex 3: Human Resource implementation County CIS Plan

	Human Resource to implement County Climate Service Plan:	
	County Director for Meteorological Service	1
	Deputy County Director for Meteorological Service	1
	Office Assistant -1 (secretary)	1
	Clerical Officer-1	1
	Drivers -2	2
	Meteorologists	3
Human resource management and	Meteorological Technologist	3
development	Meteorological Observatory staff-8 (per observatory)	16
	RANET FM Radio station Staff -18 pax (optimum)	18
	Community Climate Observers (10 per ward X 10)	100
	No. of staff promoted to the job groups equivalent to civil servants working under county Government	
	No. of staff trained for performance-related courses	All
	Rewards for both individual and groups measured by cost, quality and quantity	100

### Annex 4: County Meteorological Office Staff and Gaps

Position	Optimum	In-position	Gap	Remarks
County Director for Meteorological Service	1	1	0	
Deputy County Director for Meteorological Service	0	0	1	
Office Assistant (secretary)	1	0	1	
Clerical Officer-1	1	0	1	
Drivers -2	2	0	2	
Meteorologists	3	0	3	
Meteorological Technologist	3	0	3	
Meteorological Observatory staff	8	0	8	
RANET FM Radio station Staff	18	0	18	There is no RANET station in the county but its desired
Community Climate Observers (10per ward X 10 wards)	100			<ul> <li>Allowance 500/= per month</li> <li>Airtime and M-Pesa transaction fee 250</li> </ul>

### Annex 5 Levels of Decision Making

Level of decision making	Principal planning and sectorial bodies and frameworks which MCCISP seeks to support
County level	County Integrated Development Plan (Governor's Office) County Steering Group on Drought Emergency, (CSG) Ministry of Environment, Energy and Natural Resources Ministry of Agriculture, Water and Irrigation County Climate Adaptation Committee , (CAPC) Executive Finance Committee and Budget and Economic Forum County's Disaster Management Committee County Environment Committee
Ward level	Ward Adaptation Committees (WAPCs) Council of elders (Atumia ma thome) WRUA, Community forest associations(CFAs)

### Annex 6: Observations Inventory

Station Id	Station Name	Lat	Long	Alt	Sub County	
9137003	Malili Ranch Ltd	-1.73	37.21	1853	Kilome	Kiima Kiu / Kalanzoni
9137004	Kalembwani Machakos	-1.95	37.28	1372	Kilome	Kasikeu
9137021	St. Andrews Church – Ukia	-1.75	37.45	1219	Kaiti	Ukia
9137022	Marwa Sisal Estate – Kima	-1.9	37.2	1372	Kilome	Kiima Kiu / Kalanzoni
9137024	Nunguni School – Machakos	-1.8	37.36	1951	Kilome	Mukaa
9137028	Matiliku Health Centre – Machakos	-1.95	37.53	1097	Makueni	Nzaui / Kilili / Kalamba
9137029	Kiteta Govt. School	-1.53	37.48	1494	Mbooni	Kiketa / Kisau
9137032	Kasikeu Secondary School - Sultan Hamud	-1.95	37.38	1408	Kilome	Kasikeu
9137033	Salama Met Station	-1.85	37.25	1524	Kilome	Kiima Kiu / Kalanzoni
9137043	Mbitini R.C. Mission	-1.98	37.48	1494	Makueni	Mbitini (Makueni)
9137044	Ndibo Farm	-1.71	37.38	1603	Kaiti	Кее
9137051	Kilungu Met Station	-1.78	37.36	1829	Kaiti	Kilungu
9137056	Makueni D.O.'S Office	-1.8	37.61	1204	Makueni	Wote
9137061	Maiani Secondary School	-1.85	37.28	1317	Kilome	Mukaa
9137067	Wote Camp – Makueni	-1.75	37.63	1036	Mbooni	Waia Kako
9137068	Brothers Of St. Peter Claver	-1.73	37.56	1158	Kaiti	Ukia
9137069	Makueni Athi Camp	-1.78	37.81	884	Makueni	Mavindini

Station Id	Station Name	Lat	Long	Alt	Sub County	
9137073	Aimi Ma Kilungu Ltd	-1.8	37.21	1778	Kilome	Kiima Kiu / Kalanzoni
9137077	Kathoonzweni – Makueni	-1.98	37.76	914	Makueni	Kathonzweni
9137078	Mbooni Chief's Office	-1.66	37.45	1791	Mbooni	Mbooni
9137080	Ndauni Primary School – Makueni	-1.71	37.73	1158	Mbooni	Kalawa
9137091	Kilome District Office	-1.8	37.35	1981	Kilome	Mukaa
9137099	Mbooni Forest Station	-1.63	37.45	1829	Mbooni	Mbooni
9137100	Nzau Forest Station	-1.9	37.55	1615	Makueni	Nzaui / Kilili / Kalamba
9137101	Nthangu Forest Station	-1.68	37.56	1494	Mbooni	Waia Kako
9137102	Katende Forest Station	-1.7	37.51	1524	Mbooni	Kithungo / Kitundu
9137106	Makuli Forest Station	-1.83	37.48	1585	Kaiti	Ukia
9137112	Konza Ranch Office	-1.68	37.26	1701	Kilome	Kiima Kiu / Kalanzoni
9137116	Kamuthini Primary School	-1.88	37.3	1664	Kilome	Mukaa
9137118	Maiani Primary School	-1.86	37.3	1554	Kilome	Mukaa
9137120	Nziu Chief's Camp	-1.81	37.53	1219	Makueni	Wote
9137124	Kima Estate	-1.93	37.26	1329	Kilome	Kiima Kiu / Kalanzoni
9137127	Mbiini Primary School	-1.9	37.35	1372	Kilome	Kasikeu
9137133	Thavu Primary School	-1.95	37.78	1036	Makueni	Kathonzweni
9137134	Kathonzweni Secondary School	-1.91	37.71	1067	Makueni	Kathonzweni
9137135	Ititu High School – Makueni	-1.75	37.71	1073	Mbooni	Waia Kako

Station Id	Station Name	Lat	Long	Alt	Sub County	
9137136	Kola Sub-Health Centre	-1.7	37.45	1372	Mbooni	Kithungo / Kitundu
9137137	Kasunguni Asst. Chief's Office	-1.73	37.31	1524	Kaiti	Кее
9137138	Kitheini Primary School	-1.88	37.43	1585	Kaiti	Ilima
9137139	Kalawa Health Centre	-1.65	37.7	1158	Mbooni	Kalawa
9137140	Upete Chief's Centre	-1.85	37.35	1463	Kilome	Mukaa
9137141	Kiongwani Primary School	-1.9	37.3	1387	Kilome	Kasikeu
9137144	Kikoko Catholic Mission	-1.8	37.4	1829	Kaiti	Kilungu
9137145	Mavindini Sub-Health Centre	-1.81	37.78	1067	Makueni	Mavindini
9137146	Kiteta Chief's Office	-1.56	37.53	1219	Mbooni	Kiketa / Kisau
9137147	Ukia Chief's Office	-1.76	37.55	1219	Kaiti	Ukia
9137148	Ukia Girls Secondary School	-1.73	37.51	1372	Mbooni	Kithungo / Kitundu
9137149	Kisau Chief's Camp	-1.63	37.55	1189	Mbooni	Kiketa / Kisau
9137163	Matiani Primary School	-1.8	37.31	1798	Kilome	Mukaa
9137165	landuini Primary School	-1.86	37.33	1634	Kilome	Mukaa
9137167	Kyumbe Primary School	-1.95	37.43	1286	Makueni	Kasikeu
9137168	Kiima Kiu Primary School	-1.83	37.26	1615	Kilome	Kiima Kiu / Kalanzoni
9137169	Mukaa Primary School	-1.83	37.33	1655	Kilome	Mukaa
9137184	Kavuko Primary School	-1.88	37.28	1372	Kilome	Mukaa
9137187	Kithumba Primary School	-1.9	37.5	1219	Makueni	Nzaui / Kilili / Kalamba

Station Id	Station Name	Lat	Long	Alt	Sub County	
9137189	Kwakaseke Primary School	-1.85	37.3	1570	Kilome	Mukaa
9137191	Kalembani & Ngaamba Co. Ltd.	-1.91	37.25	1387	Kilome	Kiima Kiu / Kalanzoni
9137193	Kithumani Farmer's Co Op Society	-1.93	37.46	1561	Makueni	Mbitini (Makueni)
9137194	Mukuyuni Secondary School	-1.73	37.46	1280	Mbooni	Kithungo / Kitundu
9137203	liani Mutisya's Farm	-1.55	37.36	1402	Mbooni	Tulimani
9137205	Moses M. Mwendwa Farm	-1.71	37.41	1219	Kaiti	Kee
9137212	Kilungu High School	-1.78	37.36	1829	Kaiti	Kilungu
9137215	Nthongoni Village	-1.76	37.48	1305	Kaiti	Ukia
9237000	Makindu Meteorological Station	- 2.284174	37.820833	1004	Kibwezi West	Nguumo
9237002	Dwa Estate Ltd – Kibwezi	-2.4	37.98	914	Kibwezi West	Kikumbulyu South
9237003	Simba Railway Station	-2.15	37.6	1036	Kibwezi West	Nguu Masumba
9237005	Govt. Dispensary – Kibwezi	-2.41	37.96	910	Kibwezi East	Thange
9237013	Kiangine Camp – Makueni	-2.03	37.78	823	Makueni	Kathonzweni
9237015	Nguu Hill – Simba	-2.11	37.66	1189	Kibwezi West	Nguu Masumba
9237025	Kibwezi Railway Station	-2.41	37.96	910	Kibwezi East	Thange
9237027	Kalulini Primary School	-2.26	37.98	914	Kibwezi West	Kikumbulyu North
9237028	Ngulai Plunge Dip	-2.1	37.53	1067	Kibwezi West	Nguu Masumba
9237034	Kikumini Primary School	-2.05	37.58	1097	Kibwezi West	Nguu Masumba

Station Id	Station Name	Lat	Long	Alt	Sub County	
9237035	Mulala Chief's Office	-2.01	37.48	1234	Kibwezi West	Emali / Mulala
9237036	Ikungu Primary School	-2.23	37.85	914	Kibwezi West	Makindu
9237037	Syumile Primary School	-2.26	37.98	914	Kibwezi West	Kikumbulyu North
9237038	Mbuinzau Railway Station	-2.35	37.9	1001	Kibwezi West	Nguumo
9237044	Mwanyani Dispensary	-2.03	37.51	1372	Kibwezi West	Emali / Mulala
9237045	Maikuu Primary School	-2.48	37.95	1036	Kibwezi East	Thange
9237046	Nzeveni Mbungi Farm – Komboyoo	-2.61	37.98	1067	Kibwezi East	Ivingoni / Nzambani
9237047	Chulu Range I	-2.78	37.96	1768	Kibwezi East	Ivingoni / Nzambani
9237048	Maasai Rural Training Centre – Chyulu	-2.36	37.85	1524	Kibwezi West	Nguumo
9237052	Simba Range Station	-2.15	37.58	1036	Kibwezi West	Nguu Masumba
9237057	Uathimo Farm	-2.05	37.43	1189	Kilome	Kasikeu
9237058	Kibwezi Forestry Research Station	-2.4	37.95	910	Kibwezi West	Kikumbulyu South
9237059	Ndunguni Primary School	-2.08	37.58	1024	Kibwezi West	Nguu Masumba
9237060	National Range Research Station – Kiboko	-2.25	37.73	993	Kibwezi West	Makindu
9237061	Mumbu Farm	-2.7	37.98	1067	Kibwezi East	Ivingoni / Nzambani
9237062	Ikoyo Mwove's Farm	-2.23	37.78	987	Kibwezi West	Makindu
9237063	Muangeni Primary School	-2.06	37.6	1088	Kibwezi West	Nguu Masumba
9237064	Kaunguni Primary School	-2.4	37.85	1067	Kibwezi West	Nguumo
9237065	German Agro Action Office	-2.28	37.83	991	Kibwezi West	Nguumo

Station Id	Station Name	Lat	Long	Alt	Sub County	
9237066	Ngakaa Secondary School	-2.13	37.75	914	Kibwezi West	Makindu
9237067	Mweini Primary School	-2.05	37.68	914	Kibwezi West	Nguu Masumba
9237068	Kai Makindu Station	-2.25	37.86	955	Kibwezi West	Makindu
9237069	Mbui-Nzau Hill	-2.33	37.9	1015	Kibwezi West	Nguumo
9237070	Kiambani Benjamin's Farm	-2.35	37.8	1061	Kibwezi West	Makindu
9237071	Muuni Chief's Camp	-2.35	37.85	1033	Kibwezi West	Nguumo
9237072	Kiundwani Chief's Camp	-2.31	37.86	1010	Kibwezi West	Makindu
9238000	Mtito Andei Railway Station	-2.85	38.33	764	Kibwezi East	Mtito Andei
9238001	B.E.A. Fibre & Industrial Co.	-2.48	38.11	823	Kibwezi East	Masongeleni
9238003	Masongaleni Railway Station.	-2.48	38.05	855	Kibwezi East	Thange
9238005	Masongaleni Estate li	-2.36	38.15	701	Kibwezi East	Masongeleni
9238007	Darajani Railway Station	-2.58	38.11	784	Kibwezi East	Mtito Andei
9238008	Experimental Shambas – Kibwezi	-2.38	38	914	Kibwezi West	Kikumbulyu South
9238015	Kenani Railway Station	-2.85	38.33	608	Kibwezi East	Mtito Andei
9238016	Kanga Railway Station	-2.75	38.26	675	Kibwezi East	Mtito Andei
9238017	Kathekani Railway Station	-2.61	38.15	675	Kibwezi East	Mtito Andei
9238019	Manooni Plantations	-2.36	38.08	762	Kibwezi West	Kikumbulyu South
9238020	Ngwata Chief's Office	-2.51	38.05	881	Kibwezi East	Masongeleni
9238029	Muthingiini Primary School	-2.6	38.06	853	Kibwezi East	Ivingoni / Nzambani

Station Id	Station Name	Lat	Long	Alt	Sub County	
9238031	Kalimakoi Yumbuni F.F Project	-2.51	38.1	853	Kibwezi East	Masongeleni
9238032	Nzambani Kivuva's Farm	-2.63	38.06	851	Kibwezi East	Ivingoni / Nzambani
9238034	T.A.R.D.A. Farm – Kevanda	-2.36	38.08	735	Kibwezi West	Kikumbulyu South
9238035	Athi Primary School	-2.2	38.06	762	Kibwezi West	Kikumbulyu North
9238037	Kithingiisyo Secondary School	-2.7	38.03	884	Kibwezi East	Ivingoni / Nzambani
9238038	Ngomano Full Primary School	-2.65	38.05	890	Kibwezi East	Ivingoni / Nzambani
9238039	Divisional Agricultural Ext. Office - Mtito Andei	-2.6	38.08	838	Kibwezi East	Ivingoni / Nzambani
9238040	Kitenge'i Primary School	-2.6	38.16	838	Kibwezi East	Mtito Andei
9238041	Makutano Primary School	-2.66	38.18	722	Kibwezi East	Mtito Andei
9238042	Kiaoni Primary School	-2.28	38.1	762	Kibwezi West	Kikumbulyu North
9238043	University Of Nairobi - Kibwezi Station	-2.31	38.05	762	Kibwezi West	Kikumbulyu North

### Annex 7: Automatic Weather Stations Inventory

No.	Name	Lat (°N)	Long(°E)	Status	Recommendation
1	Makindu mete station	-2.28	37.82	operational	Maintenance
2	UON Kibwezi station	-2.31	38.05	Not operational	Maintenance
3	Kambi Mawe			operational	Maintenance

### Annex 8 Summary overview of proposed products and channels for the MCCISP

Products	Product Description	Channels for communication	Lead organization(s)
Unusual and extreme weather events	For example very heavy rain likely to cause flash flood, strong winds	All channels including via County Government Administration, churches, police, schools, local alarm systems, SMS to CIS intermediaries, via community, local and regional radio, social media	KMD direct to County Government and NDMA, police, CIS intermediaries and radio stations
Daily	Forecast of rainfall intensity, humidity at geographic location(s), Reported Rainfall Amount, Unusual weather- related events	Radio SMS	KMD to NDMA KMD to principal regional, local and community radio stations KMD to CIS intermediaries
Weekly	Forecast for next 7 days including rainfall location and intensity, temperature, cloud cover, fog, strong winds, advice on daily rate for irrigation	Radio SMS (including via schools) Email and KMD website	KMD to regional, local and community radios and CIS intermediaries on Saturday or Sunday
Monthly	Forecast for the next month on rainfall location and intensity, temperature, extreme weather events. Potentially include local knowledge	Radio and SMS Email and KMD website	KMD to regional, local and community radios and CIS intermediaries Included in NDMA monthly bulletins
Seasonal	Onset, quality, distribution, cessation of rains, extended dry spells Livelihood advisories developed with ASDSP and Ministries of Agriculture and Livestock	Participatory scenario Planning (PSP)Workshop KMD website and via email Barazas and discussions led by CIS intermediaries	<ul><li>KMD in collaboration with ASDSP and all key ministries and partners</li><li>CIS intermediaries within ongoing activities</li></ul>

	Potentially include local knowledge	Phone-in radio shows Summary by SMS	KMD with technical experts from County Ministries/research institutes KMD to CIS intermediaries
Climatological Normals and Trends	Climatological Normals are averages of climatological elements (temperature rainfall wind sunshine radioation cloudiness, ) over specified long term periods (30yeras plus) and location. Climatological trends are temporal indications of long term changes of the averages of the climatological elements.	Policy document	County government planning offices
Climate Change Prejections	<ul><li>Emission pathways projections scenarios.</li><li>Downscaled scenarios</li></ul>	Policy documents	Planning offices

### Annex 9: Makueni County Cis Plans Implementation Matrix

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	% of the households with improved resilience through use of CIS	Qualitative assessment through research	5 years	
	No of clients seeking CI (Visits)	Register of CI seekers	5 years	KMD,
What will show the increased use	No. of plans, policies responsive to CI issues	Policies and plans status reports	"	KMD, CG of Makueni,
of weather and climate information and mainstreaming	Budgetary allocations to CI issues	Budget lines	"	
into development and sector policies, plans and programmes supports sustainable development	% Increase in crop and livestock yield	Panel study Household surveys Evaluation Studies	Mid Term And End Of Project	KMS and M&E Team(from stakeholders
in the Makueni County	% contribution in incomes at	Panel study	Mid Term And	KMS and M&E Team(from
	household level	Household surveys	End Of Project	stakeholders
	Improved nutrition	Panel study Household surveys	Mid Term And End Of Project	
	Reduced poverty level	Panel study Household surveys	Mid Term And End Of Project	KMS and M&E Team(from stakeholders
OUTCOME				
What is a good measure of	Development planning should	No. of climate proof		
increased use of reliable and	be in line with dryland economic	public and private		
accessible weather and climate	mainstay of the population	investments		
services information services in Makueni County?	No of Adaptation methods taken up among communities	Field surveys		

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	No of Government policies which consider CIS as an input to dryland development			
	No of projects or initiatives for development with CIS mainstreamed			
	% rise in No of clients using CI	Survey reports	5 years	KMD, CG & partners
	% increase in the No of clients accessing Cl	Surveys reports	5 years	,,
	% increase in forest cover	M&E Reports	quarterly	KMS and M&E Team(from stakeholders
	% increase in uptake of climate smart technologies	Departmental reports	quarterly	0
OUTPUT 1				
How to know there is enabling environment for the generation, uptake and use of weather and climate services to support development	No of appropriate policies at national and county level operationalized	Reports - Mainstreamed CC within county policy and planning	Within 6 months	
	No of functional met infrastructure and partners supporting Makueni Met office	Field reports on facilities Stakeholder lists/ maps, progress reports	Quarterly	KMD, CG, and other devt partners
	No of community members and other stakeholders using CIS	Feedback Reports	Seasonal	

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	No of PSP – Participatory Scenario Planning meetings held	Reports - Nature of Advisories	Seasonal	
	No. of functional weather stations installed	Inventory of weather stations	Annual	KMD
	No of HHs using Cl for decision making	Household surveys	Annual	,,
	No of coordination meetings related to climate issues	M&E reports	quarterly	0
	No of bills passed related to climate issues	M&E reports	quarterly	KMS and M&E Team(from stakeholders
	% increase in technological uptake related to climate information	M&E reports	quarterly	0
OUTPUT 2				
What are some of the	No of collaborative initiatives at the county and grassroots	County level reports on CIS collaborative initiatives	Continuous	
What are some of the interdisciplinary activities that a) supports the generation, uptake and use of weather and climate services and (b) builds sustained leadership in climate information services in Makueni County	No. of initiatives the leadership is taking in uptake and use of CIS at grass roots level	No. of county and sub- county climate change forums No. of forums held at grass roots that generate interest in CIS New initiatives at the County	Continuous	

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	No of Scenario Planning meetings/ Cl workshops held	Workshop Reports, Minutes	Seasonal	KMD, CG & partners
	No of radio talk shows held	Audio CDs, Call-in feedback reports	,,	"
	No of CI bills passed by Makueni County Assembly	County Assembly house proceedings and order papers (hansard)	Session based	СА
	No of field visits/ barazas	Field reports	Seasonal	KMD, CG & partners
	No of CIS trainings to community climate monitors	Training reports	Semi-annual/ annual	"
	No of PSP		quarterly	KMS and M&E Team(from stakeholders
	No OF CIS participatory review meeting	Research reports	quarterly	
	No of implementation frameworks developed	M&E reports Departmental reports	quarterly	KMS and M&E Team(from stakeholders
OUTPUT 3				
How do we measure improvement in data collection, processing and dissemination for climate information and services in Makueni County?	No of functional and equitably distributed observatories that are remitting information on a regular basis	No. of stations reporting on a regular basis	1-2 years	
	Existence of data processing mechanisms and capacity at the County level	Appropriate equipment Capacity of personnel	1-2 years	

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	Existence of community weather observation system	No. of community climate monitors	1-2 years	
	Existence of robust dissemination methods to users		1-2 years	
	No of met infrastructure installed	Met infrastructure inventory	Annual	KMD, CG & partners
	No of new services / products provided or shared	CI service status / review reports on new products	Intermittently	KMD
	No of weather forecasts disseminated	Forecasts	Daily / weekly/ seasonal	KMD, WCR
	No of stations recording and transmitting weather parameters	M&E reports Departmental reports	quarterly	KMS and M&E Team(from stakeholders
	No of downscaled weather forecast		quarterly	KMS and M&E Team(from stakeholders
	No of platforms used to share weather report			
OUTPUT 4				
How do we measure strengthened national -sub- national networks and partnerships support improved	Existence of participatory process for integration of CI with local parameters	No. of County Steering Group meetings No. Climate Outlook Forums	Continuous	

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
generation, uptake and use of		No. County Climate		
climate information?		Change Planning		
		Committees		
		EW methods		
		incorporating		
		community approaches		
	No. of existing linkages at different levels – community,			
	ward, county, national			
	No of interdisciplinary	Platforms reports	Semi-annual	KMD CC and partners
	partnership meetings held	Partners reports	and annual	RMD, CG and partners
	No of partners supporting dissemination of CI	Partners reports	Quarterly, Semi-annual and annual	"
	No of people admitting having used CI	Survey reports	Annual	"
	No of MOUs developed	M&E reports Departmental reports	quarterly	KMS and M&E Team(from stakeholders
	No of joint work plans developed	M&E reports	quarterly	
OUTPUT 5				

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	No. of households, organizations, government department using CIS for planning and decision making	Surveys	Continuous	
	No of people responding to CI messages	M&E reports Progress reports	Quarterly, Semi-annual and annual	
How do we measure improved access to weather and climate	No of people participating in Cl dissemination events	Field reports	Quarterly, Semi-annual and annual	
County Ward and communities in				
County, Ward and communities in Makueni County	% increase number of institution disseminating weather information	M&E report Departmental reports surveys	quarterly	KMS and M&E Team(from stakeholders
	No of feedback reports	M&E report Departmental reports	quarterly	
		Departmental reports	quarterly	KMS and M&E Team(from stakeholders
OUTPUT 6:				
What evidence would suggest that there has been learning from effective use of CIS in Makueni	% increase in demand for CIS among communities, county government and other	Reports	Continuous	
County	development partners			

Result	Indicators	How will this be measured	Time frame	Responsibility
IMPACT				
	No of climate resilient investments at grass roots		Continuous	
	No of research papers published on CIS			
	No of research papers on CIS influencing policy at the national and county level			
	Mainstreaming of climatic change into development planning	% of County funds allocated for climate resilient development at the grass roots – Climate Change Act 2016	Continuous	
	No of case studies/ success stories documented	Case studies	Continuous	
	Increased no of people seeking climate information from service provider	Departmental reports	quarterly	KMS and M&E Team(from stakeholders
	% increase household livelihood diversification	M&E report	quarterly	
	Increase in number of DRR plans developed	Departmental reports Baseline surveys	quarterly	KMS and M&E Team(from stakeholders

### DISCLAIMER



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