Climate Change, Water Resources and Food Security in the Lower Tana River basin, Kenya

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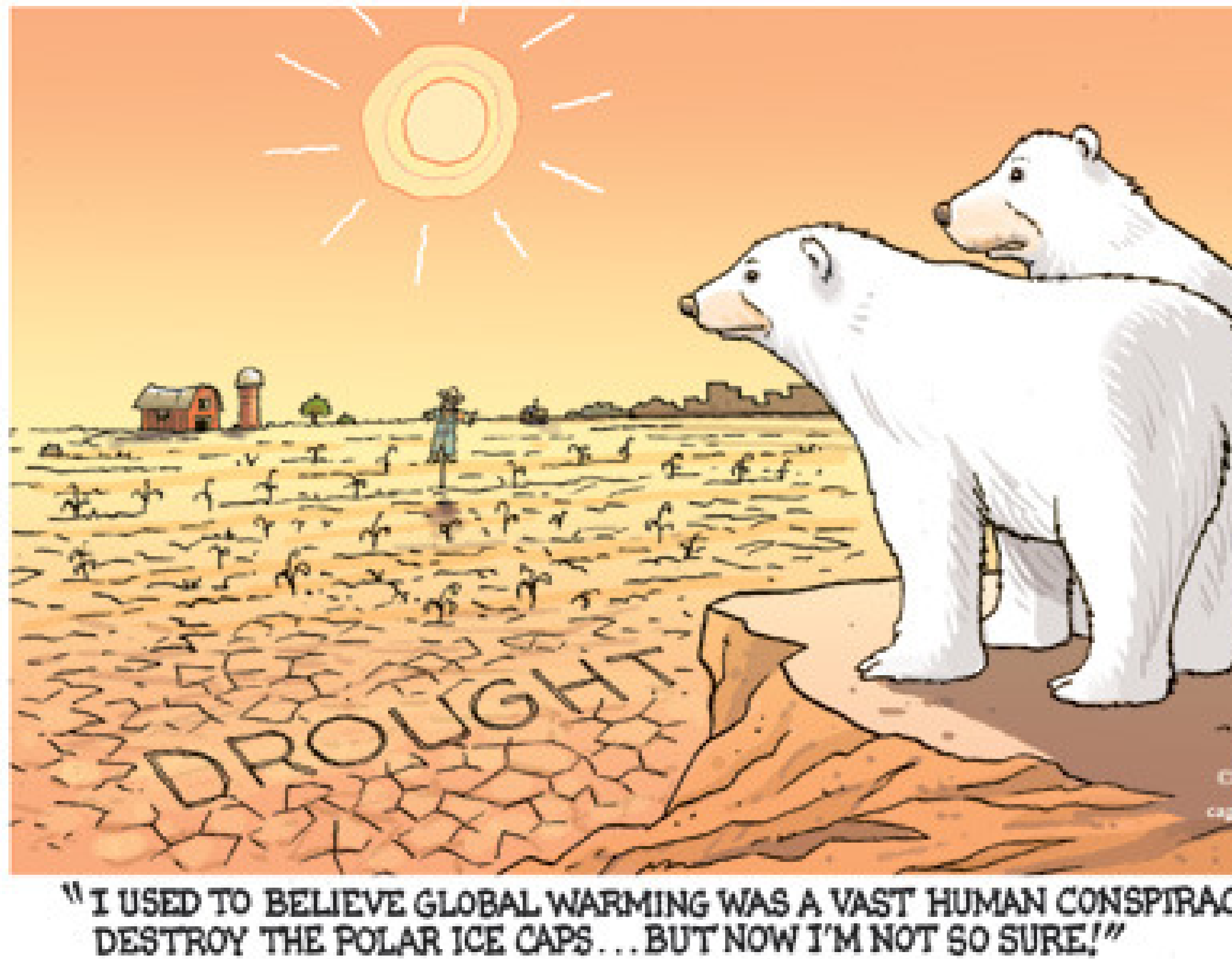
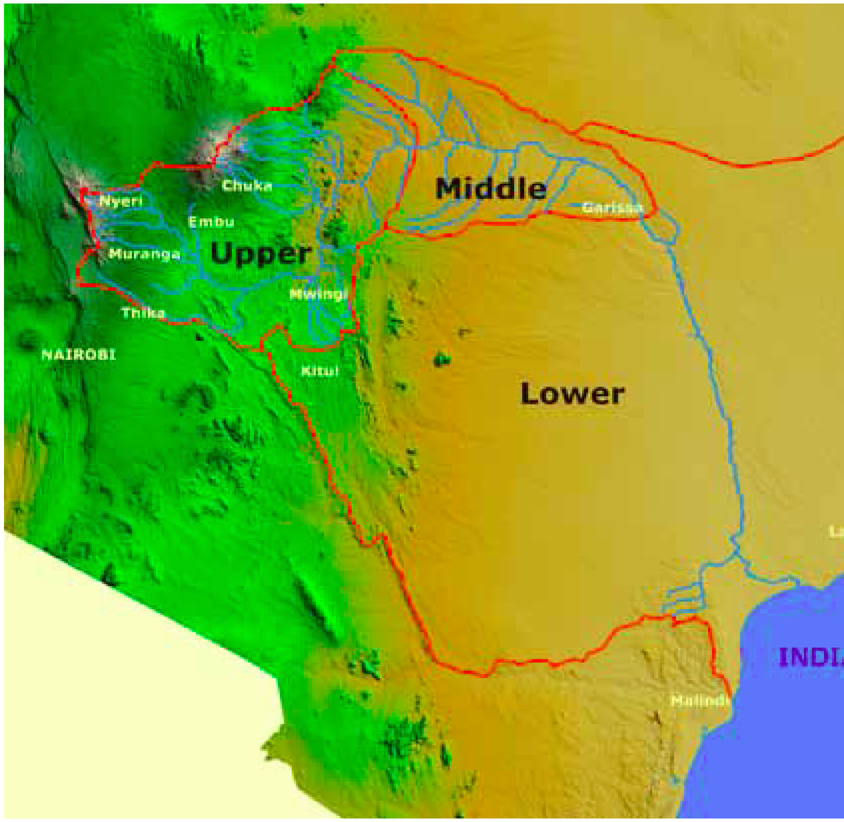


he Tana river basin

- The Tana River basin covers an area of 126,028 km². The upper basin comprises the slopes of the Aberdare and Mount Kenya mountain ranges.
- Rainfall amounts roughly correspond to the elevation.
- The highest rainfall (average of 1050 mm) is observed in the upper basin, while the lowest rainfall (average 500 mm) is in the lower basin.



ana river stages

The upper Tana is characterized by rain-fed cash crop agriculture: tea, coffee, maize but also small tree stands.

The middle and lower, drier, areas in the basin are mostly used as pastoralist grazing land, dry land farming and dry land forestry. A number of irrigation schemes are - both perennial irrigation and flood based systems along the main Tana River and some of the tributaries - are also found in this area.

The coastal area of Tana Basin, including the islands of Lamu and others, differs from the rest of the lowlands – because of the humidity and also because of the intense development along the coast

Vater in the Tana basin

- Water in the Tana basin is used for electricity generation by five main hydropower stations in Tana River – with two more being planned
- The stations are operated by KenGen providing 40 to 64% of the national electricity demand.
- Nairobi obtains 70 to 80 % of its drinking water from Ndakaini reservoir
- The third large water use comprises medium-sized irrigation schemes, covering 68,700 hectares.
- In addition to these directly productive uses of water, sufficient base flow is also required in the delta area as low base-flows caused damage to the mangrove an reef systems near the Kiunga Marine National Reserve.

he Tana river basin – protected areas

Tana Catchment Area also boasts of several protected and gazetted areas. This includes four National Parks and eight Game Reserves,

the major ones being the Aberdare Ranges, Mt. Kenya Forest, Meru National Park Tsavo East National Park and the Tana River Primate Reserve.

In these natural landscapes ecosystem management is equally important.

Main challenges in the Tana Catchment

ameter	Units	Kenya	Tana	Tana %
chment area	km²	580,37	126,026	22%
ulation	inhabitants	28,686,607	5,100,800	18%
ual average rainfall	mm	621	679	109%
ual average runoff	mm	13	29	223%
ewable surface water	million m³/capita/year	647	726	112%
face water abstractions rates	million m³/year	1071.7	595.4	55.6%
undwater abstractions rates	million m³/year	57.21	4.79	8.4%
rage borehole yield	m³/hr	6.25	6.58	105%
ehole specific capacity	m³/m	0.20	0.17	85%
ropower production	MW	599	477	80%
gation potential	ha	539	205	38%

ce: National Water Master Plan 1992; Population census 1999

Different challenges for upper middle and lower Tana

Main challenges: upper Tana

Over-abstraction locally: of surface water and, in some areas, groundwater

Catchment degradation from land use changes that may affect recharge in this unit; risk of deterioration of water quality;

A significant rate of urbanisation and related surface

Agro-based factories which also contribute to water pollution;

Encroachment of protected forests   and wetlands

Encroachment, landslides, degradation and subsequent siltation and pollution of spring heads

Localised heavy abstraction of surface water and groundwater for intensive commercial plantations (eucalyptus in particular);

Water quality – fluoride and manganese levels are high in certain locations

Main challenges: Middle Tana

Water scarcity – rainfall ranging between 400 m to 700 m;

Unevenly distributed groundwater availability and seasonal variation of shallow groundwater levels

Salinity of groundwater in several areas;

Uncontrolled sand mining

Sedimentation in reservoirs;

No protection of natural trees stands – leading to removal of trees and no regeneration;

No management of grazing areas (with a few exceptions) – as a result most palatable grasses are overgrazed and woody species take the upper hand

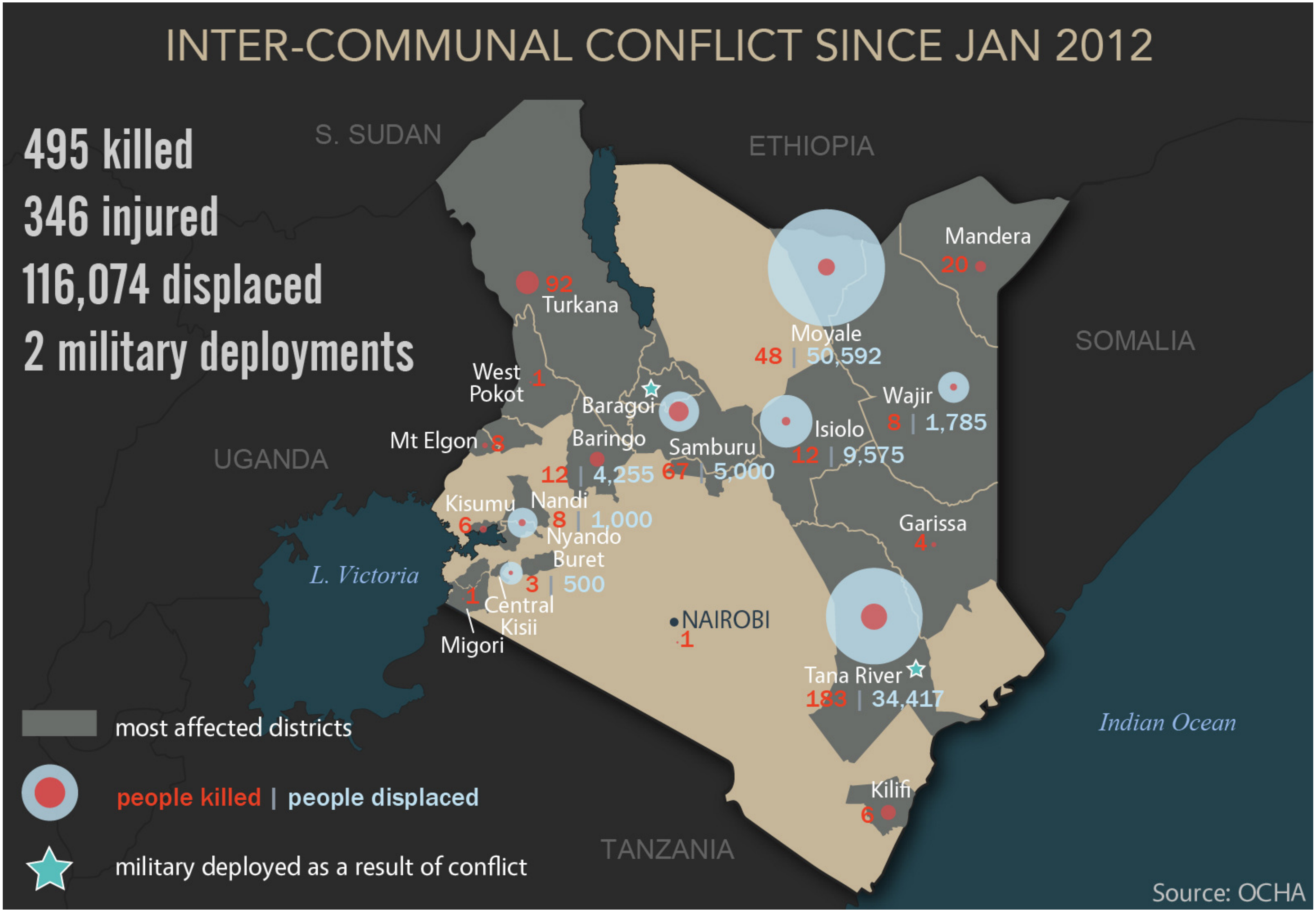
Invasion of alien species – in particular *prosopis juliflora*.

Consequences of Sand Mining

Main challenges: Lower Tana

- uctuation of water levels in the main rivers
- ater scarcity during the dry season;
- et season
- mage due to peak rainfall events
- croachment of land by invasive species
- linity of groundwater – with salinity increasing with stance from dry river streams (laghas);
- nited groundwater storage;
- coastal areas) deterioration of water quality as a result intrusion of saline water.
- n the coastal islands) groundwater pollution from werage
- er use of the southern wells of the Lamu aquifer
- bstantial competition for land and water in the Tana lta

Droughts and floods - perfect catalysts for pastoral conflicts


INTER-COMMUNAL CONFLICT SINCE JAN 2012
495 killed
346 injured
116,074 displaced
2 military deployments
S. SUDAN
ETHIOPIA
SOMALIA
UGANDA
TANZANIA
L. Victoria
Indian Ocean
Turkana 92
Mandera 20
Moyale 48 | 50,592
West Pokot 1
Baragoi
Wajir 8 | 1,785
Mt Elgon 8
Baringo 12 | 4,255
Samburu 67 | 5,000
Isiolo 12 | 9,575
Kisumu 6
Nandi 8 | 1,000
Nyando
Buret 3 | 500
Garissa 4
Central Kisii 1
Migori
NAIROBI 1
Tana River 183 | 34,417
Kilifi 6
most affected districts
people killed | people displaced
military deployed as a result of conflict
Source: OCHA

olutions for Lower Tana (our focus)

Investigating and developing all opportunities for the use of local aquifers for artificial recharge, storage, recovery of storm-runoff and any excess riverflows.

Dune infiltration in the coastal areas – from several sources – so as to safeguard the curr and future supply for urban and tourist settlements along the coast. .

Developing opportunities for small-scale surface water storage in the arid landscape,

Making best use of the flood based farming

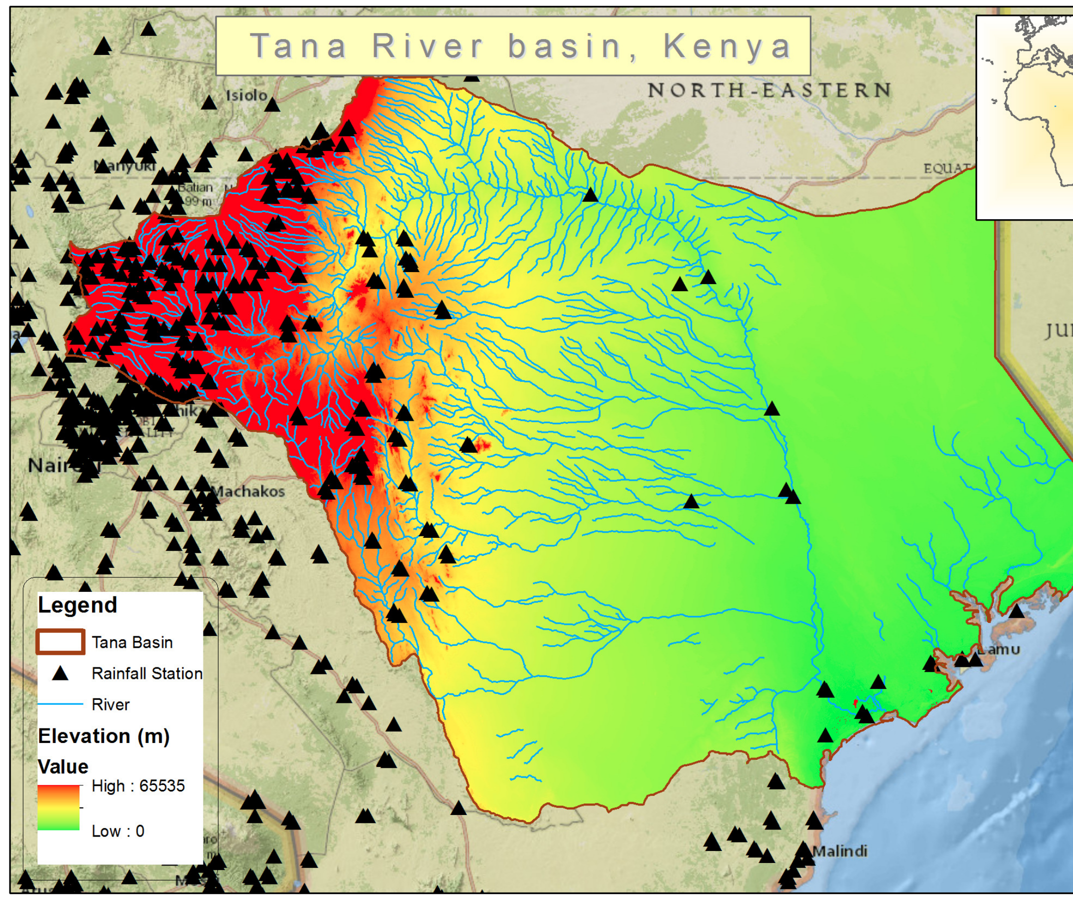
Develop a coherent participatory plan for the Tana Delta – where there are various high value landscape functions competing related to biodiversity, rangeland, and commercial agriculture.

Developing appropriate mechanisms to control the timing and quantity of artificial flood releases from the newly planned reservoirs

Planting trees and seeding grass to serve as ecosystem stabilizers.

Before we get there…

- Basin is poorly observed
- The best temporal resolution is daily
- More than 50% of reporting stations do not have data
- No existing early warning system for floods and drought
- Satellite estimates of precipitation compares poorly with the few observing stations
- It is not clear how climate change will impact this basin
  - More floods?
  - More drought?



)bserved/projected climate change

egional climate projected to
nange tremendously

Mean and extreme rainfall likely to increase

Temperature likely to increase

nat about the East African climate
ange paradox? *" observed drying d higher frequency of droughts in e last 3 decades versus the ojected wetter region by GCMs ? "*

Temperature		Rainfall	
Past Trends	Future Trends	Past Trends	Future T
At the national level, between 1960 and 2003, mean annual temperatures have increased in Kenya by 1.0 degrees centigrade per decade.	Future temperature projections indicate that the mean annual temperature may increase by 1.0 to 2.8 degrees centigrade by 2060.	In terms of rainfall, there are no statistically significant trends observed.	Mean rainfa projected to up to 48% b and within t proportion that falls wi events is pr increase by the same durat
Daily temperature observations show significantly increasing trends in the frequency of hot days and a much larger increase in the frequency of hot nights.	The frequency of cold days and nights will continue to decrease.	It has been observed that the proportion of rainfall occurring in heavy events has increased since 1960 (though this is not statistically significant).	

roject Objectives

o address **some of** these issues, we need to:

- emonstrate quantitative and qualitative improvement of water cycle observations
- emonstrate flood and drought early warning capability
- ssess climate change impacts on floods, droughts and crop production
- rototype data and information integration and sharing systems
- nprove observational, modeling and application capacity

roposed Project Approach

Demonstrate quantitative and qualitative improvement of water cycle observatior

Prototype near-real time rainfall observation and data dissemination systems by coupling satellite and in-situ measurements which are used as inputs into flood prediction.

Develop comprehensive in-situ and satellite observation data archive for improvin monitoring capability of water cycle and developing hydrological models to be use for early warning.

Develop long-term and comprehensive climate observation data archives which ar used for climate change analysis climate projection model bias correction.

Demonstrate early warning capability of water and food security

roposed Project Approach (2)

Develop coupled hydrological – crop models for converting climatological and meteorological data and information to usable information of water resources an food management

Prototype real-time data management, modeling and information dissemination systems.

Evaluate climate change impacts on floods, droughts and food production

- *Select GCMs which can express the regional climate properly.*
- *Implement bias correction and downscaling (statistical- and dynamic-) of the selected GCMs.*

roposed Project Approach (3)

Develop a socio-economic data archive

Compare changes of frequency and intensity of flood, drought and food production.

Develop an integrated water portal for improving data accessibility and data sharing.

Improve observational, modeling and application capacity

Develop training modules of satellite remote sensing, modeling, bias correction ar downscaling, make design of training courses on integrated observations, early warning and climate change assessment, and offer the courses.

Promote secondary educational programs in collaboration with universities

takeholders

Water Resource management authority (WRMA)

Kenya Meteorological Services Department (formerly KMD)

Water and Sewerage Companies – Murang'a water, Nyeri Water and Sewerage Company (NYEWASCO), Embu Water and Sewerage Company (EWASCO),

Jomo Kenyatta University of Agriculture and Technology (JKUAT),The University of Tokyo, Kyoto University ,

Power Generating companies – KenGen, Geothermal Development Company (GDC)

Tana Water Services Board, Tana Athi River Development Authority (TARDA)

Kenya Agricultural Research Institute (KARI)

Kenya Red Cross (KRC)

- NACOSTI
- Ministry of Environment and Mine Resources ,Kenya National Bureau Statistics (KNBS)
- Regional Center for Mapping of Resources for Development (RCMF
- Department of Resource Surveys a Remote Sensing (DRSRS)

Ends.

hank you