REPUBLIC OF KENYA

National Climate Change Action Plan: Knowledge Management and Capacity Development

Chapter 2.0: Climate Change Knowledge Management Strategy

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Abbreviations and Acronyms

AAP	Africa Adaptation Program
ASAL	Arid and Semi-Arid Land
CoP	Community of Practice
GHG	Greenhouse Gas
ICT	Information and Communication Technology
NAPA	National Adaptation Programmes of Action
NCCRS	National Climate Change Response Strategy
NEMA	National Environment Management Authority
SMS	Short Message Service
UN	United Nations
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
CCS	Climate Change Secretariat
SOA	Service Oriented Architecture
C2KM	Climate Change Knowledge Management System
KMD	Kenya Meteorological Department
KARI	Kenya Agricultural Research Institute
KCCWG	Kenya Climate Change Working Group
CSOs	Civil Society Organizations
GIS	Geographical Information System

2.0 CLIMATE CHANGE KNOWLEDGE MANAGEMENT STRATEGY

2.1 Introduction

2.1.1 Background

Knowledge management has increasingly become a key component of improving organisational effectiveness. It has become a truism that the greatest successes come not from those who possess the best knowledge but those who use it best. Thus corporate companies, development organisations and government institutions are now keen to harness and apply their knowledge capital effectively.

2.1.2 Introduction to knowledge management

Whereas there is no broadly agreed upon definition of knowledge management (KM), there is near consensus that it constitutes the combination of all the actions necessary for ensuring that organisations learn from past practice and make effective use of all skills and knowledge that their staff possess (Powell, 2003). Knowledge management comprises a range of strategies and practices used in organisations to identify, create, represent, distribute, and enable the adoption of insights and experiences. Such insights and experiences comprise knowledge, either embodied in individuals or embedded in organisations as processes or practices. Thus, knowledge management is perceived as the process through which organisations generate value from their intellectual and knowledge assets. Beijerse (1999) explains that knowledge management is the process of achieving organisational goals through a strategy-driven motivation and facilitation of knowledge workers to develop, enhance and use their capability to interpret data and information through a process of giving meaning to these data and information. Angus and Patel (1998) describe a four-step process view of knowledge management namely: gathering; organising; refining and disseminating. They explain that gathering is the bringing in of information and data into the system while organising is the process of associating items to subjects, giving them context, making them easier to find. Refining is the process of adding value by discovering relationships, abstracting, synthesis, and sharing while disseminating is getting knowledge to the people who can use it.

It is evident from the foregoing that knowledge management is about processes (efficiency), people, systems and technologies, methods and techniques, holistic approaches, consistency and persistence (long-term), innovation, competitive advantage, and transfer of lessons learnt. By managing knowledge, organisations can improve efficiency; improve the market position by operating more intelligently; enhance the continuity of the company; enhance the profitability of the company; optimise the interaction between product development and marketing; improve the relevant (group) competencies; make professionals learn more efficiently and more effectively; provide a better foundation for making decisions; improve communication between knowledge workers; enhance synergy between knowledge workers; ensure that knowledge workers stay with the company; make the company focus on the core business and on critical company knowledge (Beijerse 1999).

Several myths about knowledge management exist. These include the belief that knowledge management is an end in itself; complicated; only meant for professional firms and intellectual businesses; means utilising expensive technology; a fad; can be bought ready-

made off-the-shelf (it is the same for all organisations); about knowledge control; new; contained in documents; and can be acquired only through learning.

There are two approaches to knowledge management in general. While a techno-centric approach focuses on technology, organisational approach focuses on how an organisation can be designed to facilitate knowledge management processes best.

Snowden (2000:241-242) asserts that the developing practice of knowledge management has seen two different approaches to its definition. The first arises from information management and sees knowledge as some higher-level order of information, often expressed as a triangle progressing from data, through information and knowledge, to the apex of wisdom. Knowledge here is seen as a thing or entity that can be managed and distributed through advanced use of technology. The second approach sees the problem from a sociological basis. Here, knowledge is perceived as a human capability to act.

Whereas the dominant positivism paradigm of knowledge management is implicit in the Data-Information-Knowledge-Wisdom (DIKW) hierarchy model, this strategy document approaches the climate change knowledge management from an organisational view due to the specificity of the domain and diverse players in the area of climate change in Kenya.

Two types of knowledge; tacit and explicit exist. Tacit knowledge is the unwritten, unspoken but often hidden vast storehouse of knowledge held by human beings. Tacit knowledge is based on a person's emotions, experiences, insights, intuition, observations and internalised information. Tacit knowledge is difficult to harness or transfer (Polanyi, 1966; Nonaka and Takeuchi, 1995; Hansen et al, 1999). Kwanya (2009) explains that tacit knowledge is personalised and contextualised. Explicit knowledge, on the other hand, is documented and exists in publications, databases or any other media. It is easier to recognise, capture, store, disseminate and perpetuate than tacit knowledge (Sanchez, 2004; Kwanya, 2009). This knowledge management strategy is designed to accommodate both tacit and explicit knowledge on climate change.

This Strategy also takes cognisance of indigenous knowledge. Indigenous knowledge or the knowledge that people in a given community have developed over time, and continue to develop is critical in guiding decision making at community level. According to the International Institute for Rural Reconstruction (IIRR) which has developed effective methods of documenting indigenous knowledge, this type of knowledge evolves and is dynamic. Indigenous knowledge is based on experience, often tested over centuries of use, adapted to dynamic and changing local culture and environment. In a paper focused on the integration of indigenous knowledge into formal education, Owuor (2007) points out that it has been realised that indigenous people are not only more aware of but also better able to identify their own needs than are outsiders in the development process. It is therefore important for development initiatives to understand how communities cope with challenges such as environmental stress and build on these approaches rather than introducing approaches from elsewhere without incorporating local knowledge and experiences.

Knowledge management as a process faces many challenges. Some of these include information overload; lack of obvious linkages between various pieces or categories of

knowledge; diverse information and legacy systems; lack of information documentation; existence of redundant, inconsistent and obsolete information; limited human, fiscal and technological resources; diverse user and organisational interests and needs; established organisational cultures which are difficult to change; organisational politics, competition and lack of cooperation; and dynamic information needs and information seeking behaviour (Kwanya, 2009).

2.1.3 Purpose of strategy

The purpose of this Strategy is to create a comprehensive climate change information and knowledge management framework. It is envisioned that the successful implementation of this framework will result in effective dissemination of the acquired climate change knowledge to the potential users, especially the vulnerable groups. This framework will also facilitate accountability for climate change knowledge management in Kenya.

2.1.4 Strategic objectives

This Strategy will seek to achieve the following objectives:

(i) Develop an enabling environment for sharing the climate change knowledge amongst the Kenyan climate change stakeholders;

(ii) Establish a climate change knowledge management coordination framework which engages all the stakeholders;

(iii) Develop the capacity of the coordinating unit to effectively lead the management of climate change knowledge;

(iv) Develop and implement a mechanism for monitoring the application of climate change knowledge by policy makers and people at the frontline of climate change impacts; and

(v) Maintain a robust and up-to-date climate change knowledge management system.

2.1.5 Guiding principles

This knowledge management for climate change strategy is anchored on the following principles:

(i) Recognising and managing complexities: Knowledge, its sources and users are very complex. This Strategy will be sensitive to such complexities and will seek to manage them appropriately.

(ii) Focus on adoption: Knowledge management systems are only useful if they are adopted and used by the intended audiences. This Strategy will focus on developing and nurturing systems which will enhance adoption of the knowledge therein.

(iii) Deliver tangible and visible benefits: Knowledge management systems must be seen to deliver tangible benefits which result in positive change in the lives of the target audience. This Strategy will seek to generate tangible benefits of climate change adaptation and mitigation to all Kenyans.

(iv) Strong leadership: Given the complexities around knowledge management and climate change, this strategy will seek to provide a strong leadership to rally all the stakeholders and direct them towards a common goal of sharing and acting on climate change information. Where possible, climate change champions will be used.

(v) Seamless experience: This Strategy will seek to offer the users a seamless experience. All the components of the knowledge management for climate change

ecology will be integrated to facilitate seamless and transparent access and use.

2.1.6 Conceptual framework

A lot of work was put in the scoping of the institutions and experts involved in the climate change activities in Kenya. From the scoping exercise, it was clear that the majority of these stakeholders fall outside government and related institutions. It was therefore important to recognise this when developing the framework for managing climate change knowledge in Kenya. Thus the framework respects the following two principles:

(a) Principle of Autonomy - each climate change information or knowledge generator or actor has a high degree of autonomy to manage its local knowledge.

(b) Principle of Coordination - each climate change actor should be enabled to exchange knowledge with other stakeholders through the adoption of a sharing mechanism.

Figure 1 below represents different stakeholders and climate change area of specialisation.

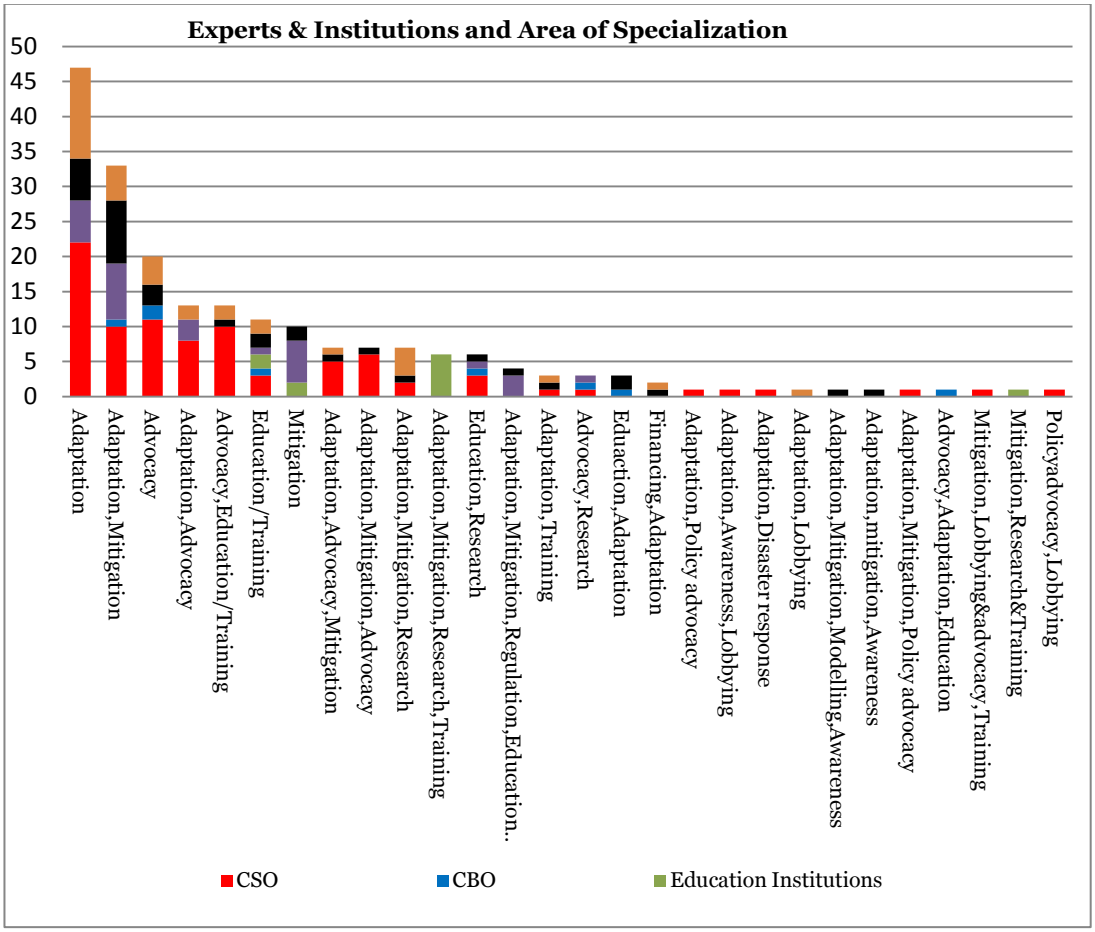

Figure 1: Various climate change stakeholders and their areas of specialisation

2.2 The Climate Change Knowledge Management Situation in Kenya

A review of the climate change knowledge management landscape was conducted to analyse the current state of climate change knowledge in Kenya. This section summarises the findings and the existing challenges.

Climate change is an emerging issue. However, there is significant amount of climate change knowledge that has been generated in Kenya by institutions and individuals carrying out activities related to the phenomenon. Below is a summary of the state of climate change knowledge management in Kenya based on a four-stage process model of knowledge management namely: generation and gathering; organisation; storage and; dissemination.

- **Generation and gathering**
  Agencies involved in climate change knowledge creation in Kenya include government, research and academic institutions, more than 300 civil society organisations (CSOs) and private sector companies. In terms of knowledge sharing, there are three main challenges as follows:

  - Existing climate change knowledge management systems are not formally integrated into a common institutional arrangement. This limits widespread access to the knowledge.
  - Kenya does not have a comprehensive directory of institutions and experts involved in climate change activities.
  - The latest Green House Gas Inventory was produced in 1994 and the country has not been making climate change vulnerability assessment as required for reporting to the United Nations Framework Convention on Climate Change (UNFCCC).

- **Organisation**
  During the development of the Climate Change Knowledge Management System Prototype, an exercise to scope existing institutions involved in climate change work revealed that most of them lack a standardised method of organising their knowledge. A good standard which they could adopt is the Dublin Core Metadata standard.

- **Storage**
  Various institutions have developed basic data bases, libraries and websites where they store the climate change knowledge they generate. Most institutions however lack electronic-based centralised systems for knowledge management. Such knowledge is mainly accessible through physical copies mostly placed in in-house libraries or stored as “hard copy” publications.

- **Dissemination**
  There is no optimal sharing of climate change information and knowledge across government, private sector, CSOs, academic, research institutions and individual researchers. A few organisations are, however, starting to share their knowledge but in a small scale. A good example is ALIN which publishes *Joto Afrika*, a quarterly magazine that carries climate change research briefings by African scientists. In 2011, ALIN

partnered with Climate Change Knowledge Network (CDKN) and CARE to develop special issues of *Joto Afrika* in the build up to CoP 17.

- **Application**
  The true value of the climate change knowledge is realised if it is appropriately used by potential users. These users could be communities impacted by climate change, policy makers as well as other users.

2.2.1 Climate change knowledge management institutional arrangement

Climate change is an emerging issue and therefore the government institutions are at the fore front of the climate change institutional arrangement. The current climate change institutional arrangement formally recognises government institutions like Ministry of Environment and Mineral Resources (MEMR), National Environmental Management Authority (NEMA), National Environment Council (NEC), Climate Change Secretariat (CCS) and Kenya Meteorological Department (KMD) among others. There are also over 300 civil society, academic and research institutions, private sector and individual researchers generating very useful climate change research work. Together they generate and or consume climate change information and knowledge. However, lack of climate change information and knowledge sharing was a common issue among the various individuals interacted with during the development of this work. Formal mainstreaming of all these actors who are generating climate change information and knowledge into the national climate change institutional arrangement will bring immense benefit to the climate change agenda in Kenya. This will create one comprehensive institutional arrangement that will allow the climate change information and knowledge to flow across the government, private sector, civil society, academic institutions and individual researchers.

There is little central documentation of all these stakeholders and areas of climate change they are involved in. This creates challenges in understanding the thematic area that is not well covered as well as contact details that makes it easier to identify climate change experts, their location and area of expertise. In addition, the consultants found no existing well-formed framework that coordinates all these groups together apart from forums that are run by the Climate Change Secretariat (CCS) where various entities involved in or affected by climate change are invited. On a positive note, the consultants also found existing initiatives in the civil society that co-ordinate various climate change actors within the sector. Kenya Climate Change Working Group (KCCWG) is taking leadership in this area with a large number of individual scientists and organisations as members of the group.

Appropriate institutional arrangement is therefore required in order to address these constraints of climate change knowledge management and information flow among the government, civil society, private sector, research institutions, individual researchers and academic institutions. The arrangement will address the generation or capture, organising, refining and dissemination of easily understandable and implementable knowledge products for the intended beneficiaries within an enabling environment.

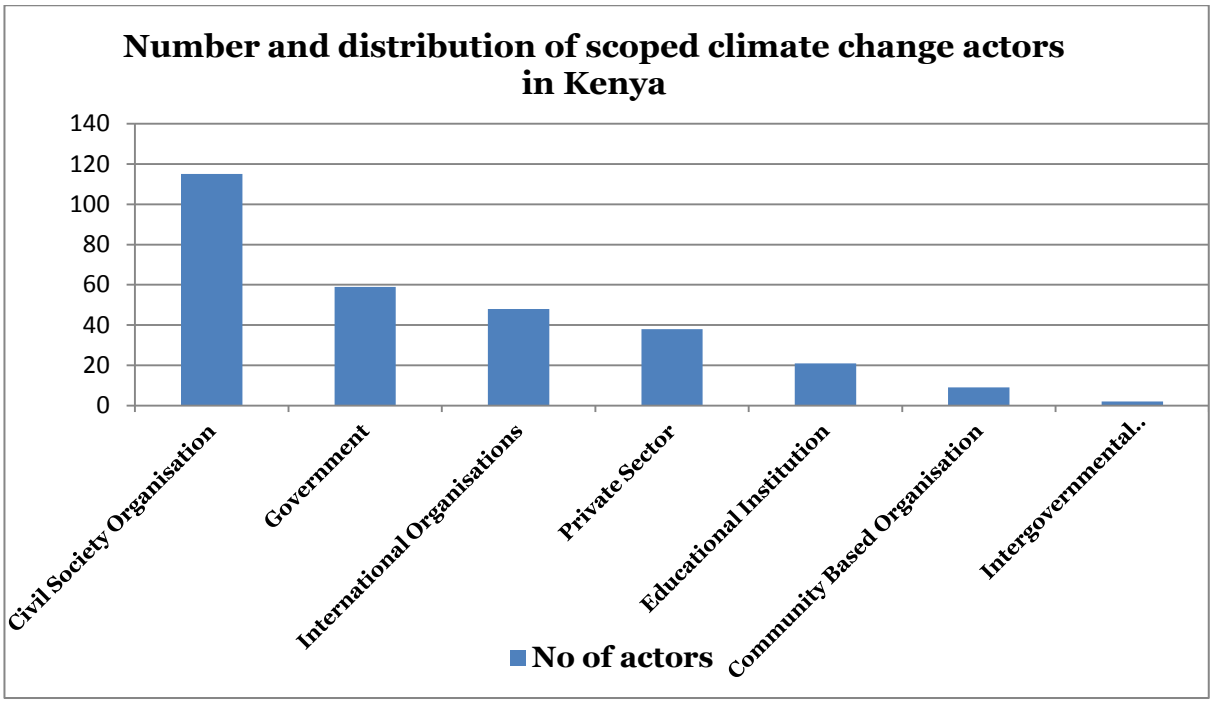

Figure 2: Number and distribution of scoped climate change actors in Kenya

2.2.2 Climate change information and knowledge status

In Kenya, a significant amount of information has been generated and experience gained that is relevant to climate change agenda. For example, most of the organisations dealing with climate change related and relevant activities like Kenya Agricultural Research Institute (KARI), Kenya Meteorology Department (KMD), National Environment Management Authority (NEMA), ministry climate change focal points, Kenya Forestry Service (KFS), Kenya Wildlife Service (KWS) and Kenya Forestry Research Institute (KEFRI) have large databases of research work done on the impact of climate change. Some of the institutions have climate change information management as one of its core mandates. For instance, KMD has one of its objectives as "extensive scientific research including monitoring, detection and assessment for climate change in the country; consistent with the regional or global issues of climate change".

Other organisations are also involved in the generation of climate change knowledge. These include the international organisations like CARE Kenya which has a large database of adaptation and coping techniques, Northern Kenya adaptation practices by Ministry of State for Development of Northern Kenya and Other Arid Lands, ALIN through its *Joto Afrika* climate change briefing magazine and Kenya Climate Change Working Group (KCCG).

In addition there is a large base of indigenous knowledge that communities have adopted as coping techniques in response to climate change effects. A case in mind is "rain making" by Nganyi community in Western Province.

While generating information is an important element of climate change knowledge management, the information would not have any impact unless it is processed, analysed, catalogued, contextualised and disseminated to those in need in a timely manner and right format. Moreover, climate change research and science is continuously being updated. New information and knowledge products in the form of coping strategies, technologies, and monitoring mechanisms are continuously being developed at the national, regional and global levels.

These knowledge products must find their way to potential beneficiaries, especially those at the forefront of climate change impacts—women, farmers, fishermen, residents of Arid and Semi-Arid Lands (ASALs), urban vulnerable groups, and coastal communities. However, there are constraining factors that prevent this information and knowledge from reaching these potential users. These include lack of enabling framework to effectively consolidate climate change knowledge and disseminate it effectively to potential users; lack of adequate data and modelling tools needed to answer fundamental questions, and specific tools needed to make more informed decisions when developing climate action plans; and little translation of the complex climate change research output into formats that can be disseminated to the potential users.

In the course of this assignment, it became evident that there was little attention given to enhance capturing, consolidating and sharing of information and knowledge that meet the needs and priorities of most of the users. Therefore, development of an inclusive climate change knowledge management framework is necessary to facilitate the effective delivery of climate change information and knowledge like mitigation and adaptation among others.

Some of the challenges constraining the participation of vulnerable groups in climate change knowledge systems are: (i) complexity of the climate change products; (ii) inappropriate dissemination channels; and (iii) lack of the awareness.

To address these constraints, it is therefore important to design climate change knowledge products that will enhance the users' understanding of climate change; improve their participation; and ensure that these products systematically and effectively address audience-specific impacts of climate change, especially those that have direct bearing on the life and well-being of the vulnerable groups.

The benefits of an inclusive management of climate change knowledge include:

(i) Cross-sector linkages of the communities of practice;
(ii) Interpretation and simplification of climate change work into products that are easily understood by the potential users;
(iii) Wide distribution of the relevant climate change information and knowledge;
(iv) Responsibility of the dissemination of climate change knowledge vested in one institution;
(v) Ease of access due to the presence of a single-stop architecture; and
(vi) Changes in the mindset of decision makers with regard to mainstreaming climate change in policies and practices due to ease of collation of climate change knowledge and information from various stakeholders to one place.

2.2.3 Climate change knowledge management systems

During the scoping of the experts and institutions engaged in climate change related activities in Kenya, it was found that databases were the most used facility to manage the climate change information and knowledge. Published climate change research work was also found to be used by a large number of organisations dealing with climate change issues.

A number of the scoped organisations also use bespoke or custom-made databases and web portals to manage the climate change information and knowledge they generate. Since these systems are developed independent of each other, it is unlikely that they follow a similar standard. Therefore integrating them requires standardisation and cooperation of the system owners.

It was also found that the majority of the organisations have physical libraries where some of the information and knowledge they generate is housed. A number of the institutions also had apprenticeship programmes to pass the knowledge to the new generation of climate change scientist and communities while other had online training portals and frequently asked questions.

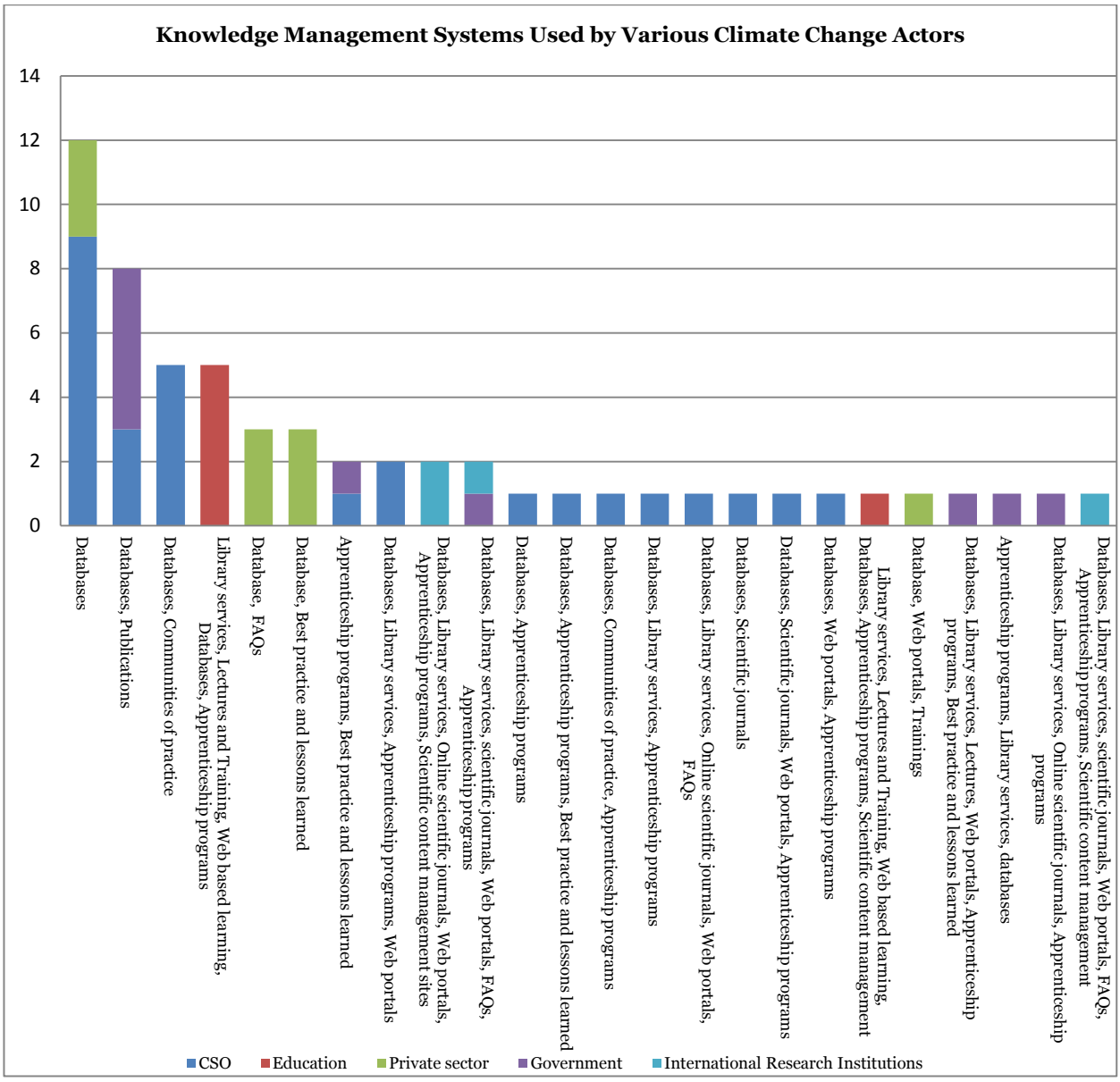

Figure 3: The distribution of knowledge management currently in use.

Box 2.1: Availability of climate information and knowledge by sector

Agriculture and rural development: The scope of agricultural impact information will need to be substantially focused on Kenya as opposed to being regional, continental or international in scope. Information must take account of precipitation levels, water distribution, and impact on farming systems involving livestock as well as crops. Systemic impacts of climate change need to be explored to identify trade-offs and opportunities. A cross-cutting approach that takes into account socio-economic factors, health or disease issues and vulnerability of the rural poor is necessary.

Human resource development and special programmes: There is a need to consider future projections of land use change to accurately assess future climate change impacts on health. Regional modelling approaches should be adopted to assess the extent and severity of the malaria problem, and distinct ecosystems as defined by terrain, topography and hydrology could be mapped to develop ecosystem-based interventions.

Environment, water and sanitation: The data and models needed to project the extent and nature of future ecosystem changes (including aquatic, coastal and marine ecosystems) and changes in the geographical distribution of species are still incomplete; the implication is that these effects can only to be partially quantified. An assessment of socio-economic impacts of climate change on the livelihoods of communities living around wildlife protected is required.

Physical infrastructure: Assessment of the potential impacts of climate change for water, waste water and storm water infrastructure is required to foster understanding of risk exposure of key infrastructural nodes to weather extremes and the impact of rising sea levels on coastal water infrastructure and human settlements.

Emissions: Knowledge of Kenya's total emissions from fossil fuels is relatively comprehensive. There is higher uncertainty attached to estimations from biomass fuels because only limited surveys have been completed on total biomass consumption in the country. There is also uncertainty when attributing emissions to specific end-uses. Indenture studies that allocate the total consumption of fuels in Kenya to specific energy end-uses would improve confidence in the analysis of mitigation options[i].

Low-carbon options: Limited understanding of the benefits of low-carbon options holds back their implementation. There is a low understanding amongst households that more efficient equipment has the potential to bring increased cost savings. Private sector institutions, especially small and medium enterprises (SMEs), demonstrate limited understanding of the potential for cost-effective energy efficiency improvements[ii].

2.3 Climate Change Information and Knowledge Users

The identification of the potential users of the climate change knowledge is an important component of this Strategy. This is because the user needs as well as the types and use cases must be aligned to the knowledge management developments. In order to identify the potential users, this Strategy sets to answer the following questions:

(i) Who is or is a potential user?
(ii) What are the users' or potential users' level of understanding of the climate change knowledge?
(iii) What is the gender, education background, geographic distribution, etc of the actual or potential users?
(iv) Why are they interested in climate change knowledge?
(v) What are their use case scenarios?
(vi) Do the users need any specific aspect of the climate change knowledge?
(vii) What do they do?

By definition, this climate change knowledge framework will be cross-sectoral and thematic. In other words, it envisions diverse users encompassing all the actors involved in climate change in Kenya and not merely serving the organisational requirements of the CCS and its staff.

The following are identified as the potential users of the climate change knowledge management system:

2.3.1 General public (Women, Men, Boys and Girls)

Ordinary citizens bear the brunt of the impacts of climate change. This group include farmers, fishermen, residents of ASALs, urban vulnerable groups and coastal communities. Sadly, this group does not get the relevant and timely climate change information or knowledge. This impairs their resilience and response to the adverse effects of the climate change. This group of users of climate change knowledge rarely if at all have the relevant educational background to extract actions from the existing complex scientific reports; they are thus left out.

This group would ordinarily use and apply climate change knowledge products that are easy to understand and apply. The right application of such simple knowledge on climate change would have enormous benefit.

Due to its diverse demographic and psychographic levels, the information needs of this group of climate change knowledge users is the most difficult to address as complex knowledge must be stepped-down into formats and languages that they can understand and apply without further interpretation. Since they are also geographically dispersed, the climate change knowledge dissemination channels used to reach them must be simple and accessible to ensure wider reach.

These users' information and knowledge needs have the following characteristics: (i) simple and with immediate application; (ii) location specific; and (iii) general knowledge or for application as adaptation technique.

Possible knowledge products for this category of users include localised climate change magazines, *barazas* (face to face meetings), climate change video clips, and SMS-based climate change knowledge, among others.

2.3.2 Policy makers and implementers

The formulation and implementation of facilitative policies on various elements of climate change adaptation and mitigation is critical to the success of the climate change response in Kenya. Some of the issues that require policy intervention include resource allocation, information sharing, legal frameworks and protocols of collaboration, technological adoption, setting of targets, climate change litigation, and regulation and standardisation, among others.

Policy makers' and implementers' information and knowledge needs are diverse and complex. In order for the knowledge to be useful, it must be collated from different sources to facilitate a single view. This would help in guiding the decisions and policy making process. These users include the politicians, government bureaucrats, researchers, private sector leaders, development partners and civil society organisations.

This group of users is also tasked with the national reporting at the global conventions for example UNFCCC. The group therefore needs timely and sufficient climate change information and knowledge to generate these reports. They would benefit from refined sector specific knowledge. In order for this group to generate the reporting to the UNFCC the following information, for instance, must be collated at national level:

(i) National inventory of anthropogenic emissions by sources and removal by sinks of all greenhouse gases;

(ii) National and regional development priorities, objectives and circumstances, of which they will address climate change and its adverse impacts. This may include information on features of their geography, climate and economy which may affect their ability to deal with mitigating and adapting to climate change. They will also require information regarding their specific needs and concerns arising from the adverse effects of climate change and/or the impact of the implementation of response measures; This is currently being generated by T21 thus making this modelling tool an important source of climate change knowledge for this group.

(iii) Distribution of climate change responsibilities within government departments, universities, and research institutions, among others;

(vi) Involvement and participation of other stakeholders; and

(v) Technical or expert groups or teams involved in the climate change related activities (inventory, vulnerability and adaptation assessment, mitigation, etc.). *This type of requirement therefore makes the inventory/directory of the climate change actors' very important component of the climate change knowledge management process.*

Due to their complex information and knowledge requirements, this group needs a total view of climate change information and knowledge at national and by sector, sub-national, regional and global levels. This may take the characteristics below:

(i) Require certain type of climate change knowledge over a long period. This may be over specific locations with similar characteristics;

(ii) Knowledge requirements are technical in nature; and

(iii) Require collated information and knowledge.

Possible knowledge products for this category of users include technical presentations, journal articles, research papers and technical briefs, among others.

2.3.3 Research and academic institutions

These institutions are involved in researching, teaching, testing and recommending best practices, technologies and approaches for climate change adaptation and mitigation. These include private and public universities, local and international research institutes and centres.

Due to their high level of education, the ability to absorb complex knowledge is high. Their information requirement is also complex. They may consume the climate change knowledge in raw form without further interpretation.

This group's information and knowledge needs:

(i) Require certain types of climate change knowledge over a long period. This may be over a specific locations with similar characteristics;

(ii) Knowledge requirement are technical in nature; and

(iii) Require climate information and knowledge possibly in raw form.

Possible knowledge products for this category of users include presentations, journal articles, research papers and technical briefs, among others.

2.3.4 Education (primary and secondary) institutions

Climate change is a long-term phenomenon. Climate change adaptation and mitigation as well as sustaining the gains made in climate change campaigns must be integrated within the activities of the next generation who will become future leaders, decisions and policy makers. It is therefore imperative that the concepts, impacts, mitigations and adaptation strategies are taught to the young generation so that they are empowered to not only participate in activities that mitigate the climate change but also equip them with the necessary knowledge to deal with climate change issues in their adulthood.

Due to their age and education levels, this group's information needs should be of medium complexity. They need scaled-down versions of the climate change technical knowledge. Therefore the information and knowledge products should be: (i) easy to read and understand; and (ii) graphical to make retention easy.

Possible knowledge products for this category of users include mobile phone applications, SMS, audio, animations and cartoons, still images, videos, non-technical journal articles, and

magazines, among others.

2.3.5 Civil Society Organisations

Civil society organisations play a critical role in advocating for appropriate climate change responses. They also advocate for the implementation of various climate change policies. They also work with communities, through various intervention projects, to respond appropriately to climate change. These organisations also have the capacity to mobilise resources for rapid and sustained climate change response and interventions. Their proximity to individuals at the forefront of the climate change impacts makes them an indispensable link between the grassroots communities and other climate change stakeholders.

This group is quite amorphous with complex climate change information and knowledge needs. The group includes individuals and organisations involved in climate change research and advocacy for climate change funding.

This group's information and knowledge needs have the following characteristics: (i) require certain type of climate change knowledge over a long period. This may be over a specific locations with similar characteristics; (ii) knowledge requirements are technical and non-technical in nature; and (iii) require climate information and knowledge in raw and processed form.

Possible knowledge products for this category of users include presentations, journal articles, research papers and technical briefs, among others.

3.3.6 Private Sector

Private sector activities can have serious implications on climate change. It is therefore important that the knowledge of their impacts and their role in climate change domain is availed to this group. Analysis of two sustainability reports from two members of private sector that is Nation Media Group and Safaricom revealed deep understanding of the impacts of the two organisation activities on environment. Safaricom sustainability report contains baseline data on total carbon emission per year and detailed plans on how to reduce the emission going forward.

This climate change knowledge would then be used by this group of users as an important input in their innovation processes in order to produce new technologies for adaptation and mitigation like green energy production, efficient production techniques that reduce emission among others. A large number of private sector stakeholders are involved in structural funding for afforestation and woodland creation in many areas. These stakeholders can also be roped in to co-finance climate change related initiatives by the government and non-governmental stakeholders.

This group's information and knowledge needs have the following characteristics: (i) require certain type of climate change knowledge over a long period. For instance energy sector climate change information; (ii) knowledge requirements are technical and non-technical in nature depending on intended use; (iii) require climate information and knowledge in raw

and processed form; (iv) require knowledge of climate change actors in different thematic areas; and (v) successes of climate change programmes.

This group's possible knowledge products include presentations, journal articles, research papers, best practices, lessons learned and technical briefs among others.

2.3.7 Development Partners

Development partners comprise of bilateral and multilateral donors as well as local, regional and international organisations which generally contribute resources and technical assistance to climate change programmes.

Donors and development partners would like to know the impacts and lessons learnt in relation to the projects they fund. They would also like to benchmark similar projects in different locations. They would also be interested in identifying possible mitigation or adaptation projects that they would like to support like green energy initiatives, transport projects among others. Climate change funds governance would also be of interest to this group.

This group's information and knowledge needs have the following characteristics: (i) are technical and non technical in nature; (ii) require knowledge of climate change actor in different areas of climate change; and (iii) knowledge of successful of climate change programmes.

Possible knowledge products for this category of users include presentations, journal articles, research papers; lessons learnt reports and technical briefs, among others.

2.3.8 Media

Several studies and engagement forums have confirmed that most people get climate change information through the mass media. For instance, scholars such as Boykoff and Rajan (2007) assert that the mass media is still the main source of information and opinion for millions of readers and viewers through newspapers, magazines, television, radio and the Internet. This view was also confirmed by the results of the focus group discussions and interviews with stakeholders who revealed that the mass media is a leading source of climate change information in Kenya.

It is therefore important that journalists have the right climate change information and knowledge in the right formats. This climate change information and knowledge must also be credible to avoid misreporting. With adequate climate change information, the media can reach a wide audience and influence public opinion on climate change.

This group's information and knowledge needs have the following characteristics: (i) are non-technical and must be translated into a form that the media can easily understand to avoid misreporting; and (ii) knowledge of successful of climate change programmes.

Possible knowledge products for this group of users include video footages, non technical presentations, and journal articles, among others.

2.4 Key Recommendations

In response to the issues identified in the situation analysis, the consultants came up with several key recommendations to remedy the situation. These recommendations are framed as shown hereunder:

(i) Development of the strategic objectives for climate change information and knowledge management in Kenya; and
(ii) Detailed description of the recommended redesign of the climate change organisational and information architecture.

2.4.1 Climate Change Knowledge Management Strategic Objectives and Responses

The vision of this framework is to establish a comprehensive climate change knowledge management framework that leverages all existing climate change knowledge resources. The goal is to contribute to the attainment of Kenya's climate change resiliency by providing ready nationwide access to and sharing of climate change knowledge resources among the community of practice and people who need access to climate change knowledge.

The specific objectives of this Strategy and corresponding mitigating actions are presented hereunder:

Objective 1: Establish a national institutional arrangement for climate change knowledge management

Imperative:
In Kenya, climate change knowledge resides in a complex network of individuals, systems and procedures. This network is established in the form of social and technological relationships. The relationships reflect vital interests and mutual interest in climate change issues. Accessing and using this climate change knowledge network will involve understanding and maintaining the integrity of the underlying relationships.

Due to the autonomous nature of the stakeholders involved in the climate change domain, it is important to maintain this autonomy in the climate change knowledge sharing environment. This autonomy is underpinned by the diverse nature of the stakeholders drawn from government institutions, CSOs, private sector and individual researchers. It is therefore impossible to regulate this group.

For the climate change knowledge management framework to succeed, the ministry must set up an institutional arrangement to manage the vast sources of the climate change knowledge and information. This must be guided by the fact that the number of the organisations and people involved in climate change relevant work is huge and will require a central coordination function whose role will be to ensure that the organisations continue generating the climate change knowledge and that this knowledge is transformed in a way that eases its access by all the potential users. This proposed model is designed

around other similar models that have worked well to bring the government, CSO and private sectors together to share climate change information and knowledge; for example Nepal model.

Creating a collaborative culture may require redesigning climate change stakeholders' values and implementing incentives to encourage their participation in meeting the goals of climate change knowledge management. Climate change stakeholders need to appreciate the value of sharing information. Rewards, whether peer esteem or acknowledgement, need to recognise knowledge sharing.

Enablers:

- Goodwill of the organisations involved in climate change activities to share their knowledge;
- Funding of a new knowledge management unit to manage this network or expansion of existing unit within the ministry; and
- Capacity building of the climate change coordinating node.
- A robust incentive programme to attract quality stakeholders into the climate change knowledge sharing network.

Actions:

Set up a network of climate change knowledge generators such as communities of practice, also known as Knowledge Partners with linkage to the knowledge consumers. This network will have a central coordinating node with sufficient capacity to coordinate other nodes, collate all the climate knowledge being generated by these partners, and transcribe this knowledge in formats that satisfy all potential users. The transcription of the knowledge can be done at local level of the knowledge partners or through other knowledge partners with requisite skills set. The sharing of the climate knowledge should be formalised through signing of data sharing agreements between the generators and the CCS or the entity that will be tasked with coordinating the climate change knowledge management in Kenya.

Risks:

- The slow pace of necessary institutional, legal, and regulatory adjustments and programming to mainstream climate change information and knowledge sharing;
- Delays in the assignment of qualified personnel to manage and coordinate the Climate Change Knowledge Management (CCKM) Network; and
- Lack of coherent policies to tap into tacit knowledge from the communities of practice and express these in products that can foster sharing.
- Lack of relevant incentive model to compel the CSO and private sector to join the network. Important lessons can be borrowed from the Nepal climate change knowledge management model which has over 35 institutions in their network
- Autonomous nature of the climate change information and knowledge generators and voluntary information sharing mechanisms especially from the CSO and private sectors may pose a challenge

Responsible

Climate Change Secretariat.

The recommended architecture is to have the central node (unit) housed at the CCS of the Ministry of Environment and Mineral Resources; satellite nodes in key line ministries and agencies; and collaborative partnerships with CSOs, private sector, other national and regional climate change adaptation institutions, and networks. This institutional arrangement (network of the climate change knowledge partners) will have:

- Clearly defined functions, operational and administrative responsibilities, and protocols;
- Clear mission, organisation, and implementation mechanisms to enable effective coordination, administration, and management of the climate change knowledge; and
- Resource mobilisation plans complete with cost estimates and a phased implementation plan.

This approach to climate change knowledge management therefore will be based on the Distributed Knowledge Management (DKM) model. DKM is an approach to knowledge management based on the principle that the multiplicity (and heterogeneity) of perspectives within complex organisations is not necessarily an obstacle to knowledge exploitation, but rather an opportunity that can foster innovation and creativity. The DKM approach creates a system in which activities are located to those locations or entities where it is best performed, determined for example, by skills, costs or resources (Galbraith and Lawler, 1993). This distribution may involve independent organisations (in this case climate change knowledge generators) performing each their value-added activities. The distributed knowledge model relies upon knowledge specific decision support with symmetric incentives for peer production of knowledge (Bonifacio, Bouquet and Cuel, 2002).

This Strategy proposes to model the climate change knowledge generators as a "constellation" of knowledge partners which are autonomous and with locally managed knowledge sources. In this approach, a knowledge management system becomes a tool that must support two qualitatively different processes: i) the autonomous management of knowledge which is locally produced within a single knowledge partner (principle of autonomy); and ii) the coordination of the different knowledge nodes without centrally defined semantics (principle of coordination).

This is designed to create, nurture and utilise communities of practice for knowledge management. A community of practice is defined as a unique combination of three elements: 1) a domain of knowledge, which defines a set of issues; 2) a community of people who care about this domain; and 3) the shared practice that they are developing to be effective in their domain. Communities of practice are formed by people who engage in a process of collective learning in a shared domain of human endeavour such as a group of institutions involved in climate change research, a network of surgeons exploring novel techniques, a gathering of first-time managers helping each other cope. In a nutshell, communities of practice are groups of people who share a concern or a passion for something they do and learn how to do it better as they interact regularly (Wenger, 2006).

Communities of practice, as envisioned in this Strategy, are groups of like-minded, interacting people and or organizations who filter, analyse, invest and provide, convene, build, and learn and facilitate to ensure more effective creation and sharing of climate

change knowledge. Whereas in a broad sense communities of practice cannot be legislated, in this proposed model, there is a good opportunity to create an overarching policy for the government affiliated members of the community to share knowledge with peer organisations and the coordinating central unit. This knowledge then can be shared with all the potential users.

It is envisioned that the distributed knowledge management system on climate change will have decision and policy makers, researchers, private sector, relevant government organisations, civil society organisations, communities and individuals as members. Therefore this model democratises the access to climate change knowledge as the members embrace sharing of climate change knowledge as a concept.

The major advantages of distributed knowledge management model are that it:

(a) Ensures continuous generation of knowledge and knowledge products;
(b) Reduces the resource requirements at the central node;
(c) Eases the acquisition of information and knowledge required to develop reports for communities of practice conventions; and
(d) Rides on existing climate change infrastructure hence require little monitory resources to implement.

Figure 4 below represents the distributed climate change information and knowledge management conceptual framework proposed by this Strategy.

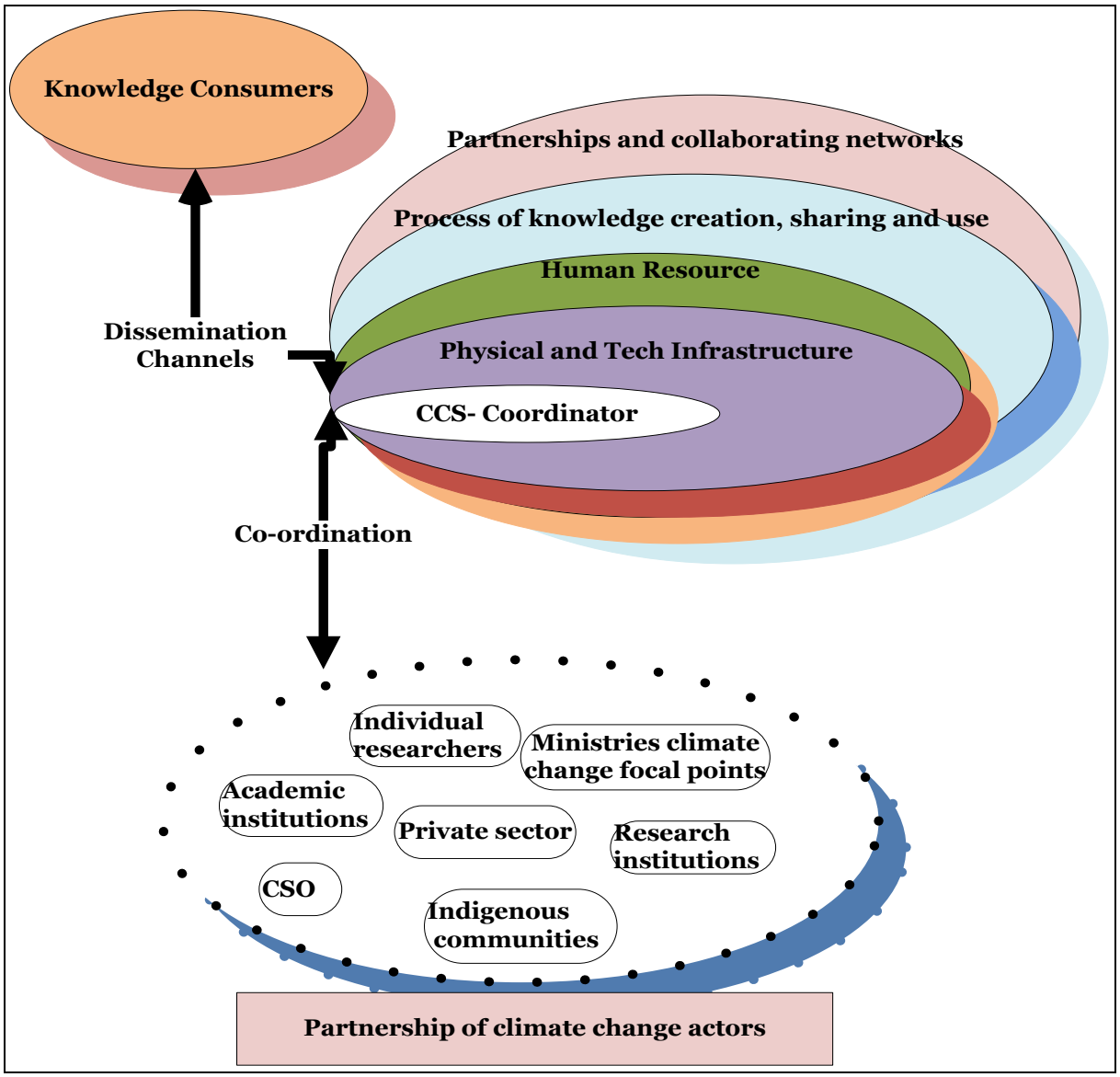

Figure 4: Distributed climate change knowledge management conceptual framework.

Core functions of Climate Change Knowledge Management (CCKM) Network

The climate change knowledge management network (CCKM) will be the main generators of climate change information and knowledge in Kenya. The central node (coordinating Knowledge Partner in this case CCS or any other designated entity like climate change resource centre) of the network will oversee the implementation and management of an online repository of the generated information and knowledge products relevant to climate change issues. It will also disseminate this information and knowledge, including information on the differential impacts of climate change—across all genders, classes, ages, abilities and ethnic groups.

The network's central node will also host and disseminate updated climate change relevant information and knowledge products in appropriate formats (e.g. web-and paper-based, leaflets, radio broadcasts, videos, animations, still images and brochures) with inputs that include: (i) Climate change relevant information available from national, regional and global sources, including the differential impacts of climate change across genders, classes, ages, abilities and ethnic groups; and (ii) Proceedings of seminars, stakeholder workshops, focus group discussions, progress reports, and other climate change relevant information and knowledge products.

The network will include communities as generators (knowledge partners) of knowledge and promote peer-to-peer and lateral knowledge sharing across all the stakeholders in the climate change domain. To promote both dissemination and interaction in wider scale, mass and social media will be used to facilitate broad knowledge sharing across significant portions of the communities that are (and will likely continue to be) affected by climate change[1].

From the attendance of the county forums it was clear that most of the climate change knowledge does not reach the potential users such as farmers and fishermen. It is, therefore, important to put in place interventions to enhance access to climate change information and knowledge products. This should be implemented within the context of the wider Network and associated institutional arrangement with emphasis on gender sensitivity, particularly in generating climate change-relevant information.

Key responsibilities of the coordinating partner (CCS) of Distributed Climate Change Knowledge Management Network

According to the proposed model, the knowledge management tasks and responsibilities are to:

- identify the necessary changes to foster climate change knowledge sharing;
- support and promote network learning by building a culture that fosters open communication, expert networking, etc;
- design the climate change knowledge management framework at the level of the whole

[1] *See public awareness and communication chapter for further details.*

network;

- work for building a knowledge management infrastructure (design, implementation, monitoring, evaluation of human, resource centres, and technological resources, etc);
- handle the identification, acquisition, organisation, protection, distribution and sharing of knowledge resources;
- coordinate knowledge management programmes and systems;
- coordinate the process of creating and using knowledge (development of new products and services, market research, etc); and
- Coordinate the relationships with external partners and providers of information and knowledge.

Incentives to encourage partners to join the climate change information and knowledge sharing network

It is recommended that an incentive programme be put in place to encourage all the existing organisations and individuals engaged in climate change activities to join the proposed network. The network is positioned to be the authoritative source of climate change information and knowledge in Kenya. It will therefore be beneficial to the climate change knowledge generators to join the network. The following are examples of the incentives that can be proposed to potential partners of the Network: (i) Access to wide range of professionals involved in climate change; (ii) Peer recognition; (iii) Access to the government-generated data for free or at subsidised cost; (iv) Acknowledged and credited by the MEMR as a National Climate Change Knowledge Partner; and (v) First priority access to the proposed national climate fund as proposed in the work of subcomponent 8

Objective 2: Develop the capacity of the coordinating unit to effectively lead the management of climate change knowledge

Imperative:
A well-staffed team with a strong team leader and "cross-sectoral" expertise is essential for the successful implementation of the climate change knowledge management network envisioned in this framework. The central node of the climate change knowledge management network must be able to answer the following questions:

- Who in the climate change knowledge management network has what knowledge?
- How do they work with it?
- Who else needs it and in what form?
- How might it be categorised so that people who need it can easily find it?

Enablers Recruitment of the people with the following skills: • Subject matters in climate change; • Project management; • People management with strong engagement skills and experience; • Experience in change management; • Librarianship • Information Technology (IT); and • Public communication.
Actions: • Recruitment of the necessary personnel; and • Development of a strong engagement plan with stakeholders (knowledge partners).
Risks: • Lack of funding; and • Government bureaucracy may delay the process.
Responsible Climate Change Secretariat.

Objective 3: Develop and maintain a robust and up-to-date climate change knowledge management system

Imperative: The key requirement for strategic decision making is good knowledge and information and, with this objective, use of ICT can significantly contribute to easing of collection, storage, access, collation and dissemination of climate change knowledge and information. Since the current climate change knowledge management systems existing Kenya are developed independently by the various organizations, they are therefore likely to be incompatible and difficult to integrate because they are based on disparate standards It is recommended that CCS implement a technology-based climate change knowledge management system using industry standard like Dublin Core Metadata. This standard will be adopted by knowledge partners to enable integration of the knowledge they generate into the centralized system. It is also recommended that the implementation is based on a phased approach. The system will serve as one stop online space where most of the climate change information and knowledge in Kenya reside providing potential climate change knowledge users in Kenya with a resource to explore, evaluate, synthesise, and learn about climate-related information and knowledge like climate change vulnerabilities, environmental impacts, disaster risk, and socio-economic datasets, as well as synthesised products such as climate adaptations, mitigation, and climate change risks, which are built and packaged for specific user-focused functions such as climate change indices for a particular region at multiple levels of details. The system will also have cross linkage with similar systems outside the country to capture experiences and lessons learned from other regions. The development of this can be scaled from the prototype developed as part of deliverables for SC7.

Enablers: Funding for the full climate change knowledge system.
Actions: Sourcing for the funding and appropriate partners to implement the full system
Risks: • Lack of funding; and • Non-acceptance of the system by the stakeholders.
Responsible Climate Change Secretariat.

Objective 4: Develop and implement a mechanism for monitoring the application of climate change knowledge by policy makers and other users

Imperative: This is the most important objective of the climate change knowledge exchange process as it is where the true value of knowledge management is realised. The experiences learnt in one community by application of certain mitigation or adaptation action replicated in another region would be a good indicator of value of climate change knowledge management
Enablers • Definition of correct and justifiable measurement and indicators. • Feedback mechanism for the climate change information and knowledge use.
Actions: • Develop a monitoring and evaluation system and utilise it to collect, analyse and report on the outcomes of the implementation of the specific actions recommended in this Strategy. This should be used to make decisions on any interventions needed to ensure successful implementation. • Develop a feedback mechanism for use of the climate change information and knowledge by all the members of the climate change information and knowledge network.
Risks: Use of wrong measurements and indicators may give a wrong picture
Responsible Climate Change Secretariat.

Objective 5: Establish a Climate Change Resource Centre

Imperative:

The physical dimension of climate change information and knowledge management involve having, an organized physical space that will house hard copies of published multimedia materials and other knowledge products on climate change. Our recommendation is to establish one national climate change resource and then use the existing infrastructure to devolve to the counties. We recommend partnership with Kenya National Library Services (KNLS) to house the climate change information and knowledge products at the county levels as this is their core business

As a facility within the MEMR, the Climate Change Knowledge Resource Centre is an organised physical space that will house hard copies of published, multimedia materials and other knowledge products on climate change in Kenya. These materials will be acquired by MEMR from commercial establishments or other agencies, national or international, involved in climate change; contributed by CSO, private sectors and international research institutions; and solicited from government institution and the academia. Examples of these are books, manuals, reports, policy documents, agreements, hazard maps, posters, videos, still images, audio and other reference materials. These will be catalogued and indexed for easy retrieval and circulation. It will provide library services to MEMR and the general public on climate change issues. During the development of this Strategy the consultants interviewed AAP and they were informed that there are already plans to build special purpose climate change library and resource centre at the KMD headquarters. Instead of building a new resource centre, it is recommended that CCS will use the same facility.

Climate Change Knowledge Resource Center may also contain a live exhibit area or a semi-permanent climate change interpretive center. An environmental interpretive or interpretation center is a facility for the dissemination of knowledge of nature. Sometimes called eco-museums, interpretation centers use different media to enhance the understanding of nature. To aid and stimulate the discovery process and the visitor's intellectual and emotional connection to nature, the main presentation strategy tends to be user-friendly and interactive, and often use exhibits and multimedia programmes. The Climate Change Knowledge interpretation center may contain temporary exhibit modules. Unlike traditional museums, it will not aim to collect, conserve and study objects. The Climate Change Knowledge interpretation center will be a specialized fixture for communicating the significance and meaning of climate change to educate and raise awareness.

Enablers

- Financing for the physical centralised resource centre.
- Ability to recruit other partners like Kenya National Library Services.

Actions: • Identify the financiers of the national climate change resource centre. • Identify the land where the centre will be built. • Tender for the architectural designs. • Tender for the construction of the centre.
Risks: Lack of funding.
Responsible Climate Change Secretariat.

2.4.2 Indigenous Climate Change Knowledge Management

Indigenous communities have long been recognised as being particularly vulnerable to the impacts of climate change due to the close connection between their livelihoods, culture, spirituality and social systems and their environment. At the same time, however, this deep and long-established relationship with the natural environment affords many indigenous peoples with knowledge that they have long used to adapt to environmental change, and are now using to respond to the impacts of climate change.

The potential of indigenous knowledge for informing observations of and response to climate change is an area of growing interest, particularly for those working at community level where access to other forms of "scientific" knowledge are inaccessible or incomplete. Increasingly, in international forums such as the United Nations Framework Convention on Climate Change (UNFCCC) and Intergovernmental Panel on Climate Change (IPCC) are steadily giving space to indigenous knowledge. While this potential is exciting and may offer new ways to directly engage local communities in action on climate change, it also brings with it important concerns about power, rights and ethics in engaging with these kinds of partnerships. These key issues guide the provision of resources for better understanding of the relationship between indigenous knowledge and climate change, the potential this relationship may hold, and the challenges that may underlie it. This is prominently exhibited in the work done by KMD among the *Nganyi* community in Western Province where the community did not want to share their rainmaking skills with outside communities. Building trust with these communities is there key ingredient to sustainable management of this indigenous knowledge.

Indigenous knowledge is now recognised as a powerful tool for compiling evidence of climate change over time and is beginning to be seen as a tool for forecasting seasonal climate information. In Kenya where the technical infrastructure available for climate observation and forecasting is limited, this may offer an important resource for a wide range of stakeholders including researchers and communities. For example the Borana people of northern Kenya have traditionally used the behaviour of their cattle to forecast drought and therefore plan for drier seasons. It is therefore important to integrate indigenous and scientific forecasting to improve its accuracy and uptake at local scales.

Despite the clear value of linking indigenous knowledge to action on climate change, it is important to consider how engaging with the communities who hold this knowledge may raise issues of rights, ethics or social justice. The ethically questionable expropriation of indigenous knowledge in industries such as pharmaceuticals and cosmetic industries underscores the importance of meaningful participation of indigenous communities in planning, approving and implementing processes that involve their knowledge or resources.

Most of the indigenous knowledge exists in a tacit form. The three major recommended approaches to be used to capture tacit knowledge from groups and individuals are: (i) interviewing indigenous knowledge experts ;(ii) learning by being told; and (iii) learning by observation.

Interviewing experts can be done in the form of structured interviewing or by recording

organisational or communities' stories. Structured interviewing of experts in a particular subject is the most commonly used technique to capture pertinent tacit knowledge. The interviewing would be very important in codifying the existing indigenous knowledge. All of these approaches should be recorded in order to transfer the tacit knowledge into reusable explicit knowledge.

We recommend use of the IIRR framework for documenting the indigenous knowledge. This model advocates for open access so the indigenous communities are informed of the open access if they volunteer their knowledge. This model is appropriate due to complexities of patenting the indigenous climate change knowledge. It is also difficult to compensate the whole community for this knowledge. In addition, it is recommended that these indigenous communities be recruited into the climate change knowledge management network.

2.5 Climate Change Knowledge Management Enablers

2.5.1 Technology

Climate change is an imposing challenge faced across all continents. Developing economies like Kenya are no exception. Climate change is impacting not just agriculture but rural ecosystems more broadly and urban environments as well. Kenya can learn from the mistakes of the other countries and adopt technologies which have worked. These technologies may include information and communication technologies (ICTs) used in the management of climate change information and knowledge.

ICTs have multiple relationships with climate change issues. For instance, the ICT sector itself and operation of the technology contributes over 2 percent to the global carbon emissions (Milosevic, 2011). On the other hand, ICTs could play an important role – through "smart" applications – in reducing the carbon footprint of sectors contributing the other 98 percent of emissions. ICTs will also have an important role to play in the development of adaptive capacity (Ospina and Heeks, 2010). In this framework, the focus is not specifically on mitigation or adaptation but on ICTs' relation to climate change information and knowledge management strategy. That is, the power to easily avail climate change information and knowledge to the government policies making processes, civil society climate change initiatives and other high level plans to address the challenge of climate change through enabled access and awareness by using the relevant ICTs.

The key requirement for strategic decision making is good knowledge and information and, with this objective, use of ICT can significantly contribute to ease of collection, storage, access, collation and dissemination of climate change knowledge and information. ICTs can be used to form a clearinghouse mechanism providing pointers to distributed climate change knowledge and information for decision makers, policy planners, scientists and engineers, researchers, and media, among others.

There are five advantages of using technology as an enabler to knowledge management. These are learning, sharing, connecting, consolidation, and innovation.

Learning: Users acquire knowledge from the technology-based knowledge management platform but are not able to contribute their own.

Sharing: Users exchange knowledge and information they have acquired. This is a critical component of knowledge management which facilitates adoption.

Connecting: The primary purpose of the technology based knowledge management platform is to enable users to connect and constantly interact with each other. Such a platform only ensures that those directly involved in the exchange of knowledge and information are aware of what is being contributed as opposed to the whole community and will neither process nor be directly responsible for archiving the knowledge shared among the users.

Consolidation: If a technology-based knowledge management platform is set up to consolidate knowledge, it collates processes and summarises the vastest quantity of knowledge possible that relates to its topic(s) and theme(s) of interest. The main function of a knowledge management system is to help its users to assimilate vast quantities of knowledge by offering it to them in digested, ready-to-use formats.

This knowledge will be gathered from a variety of sources external to the platform, including from its users. Notably, though a consolidating platform processes the knowledge it collects, it never complements it with original knowledge of its own.

Innovation: An innovation platform collects and processes existing knowledge and attempts to use it to move beyond the status quo, challenging existing assumptions and generating new ideas, perspectives and findings.

It should be noted that it is possible, and in many cases desirable, that one knowledge management system or portal should serve all the five functions.

The common types of ICT-based knowledge management systems include: (i) Groupware systems; (ii) The intranet and extranet; (iii) Data warehousing, data mining and online analytical processing system (OLAP); (iv) Decision support systems; (v) Content management systems; and (vi) Document management systems.

(i) ***Groupware systems:*** Groupware is a term that refers to technology designed to help people collaborate and includes a wide range of applications. These include communication, conferencing and collaborative management.

(ii) The intranet and extranet: The intranet is essentially a small-scale version of the internet, operating with similar functionality, but existing solely within the organisation.

(iii) Data warehousing, data mining and OLAP: The goal of storing data in a centralised system is thus to have the means to provide them with the right building blocks for sound information and knowledge. Data warehouses contain information ranging from measurements of performance to competitive intelligence.

(iv) Decision support systems: The role of these systems is to provide access to and manipulate data. They usually work with a data warehouse, use an online analytical

processing system (OLAP), and employ data mining techniques. The goal is to enhance decision-making and solve problems.

(v) Content management systems: Content management systems are very relevant to knowledge management since they are responsible for the creation, management, and distribution of content on the intranet, extranet, or a website. A content management system may have the following functions:

- Provide templates for publishing;
- Making publishing easier and more consistent with existing structure or design;
- Tag content with metadata, which is allowing the input of data that classifies content (such as by keywords) so that it can be searched for and retrieved;
- Make it easy to edit content;
- Version control - tracking changes to pages and, if necessary, allowing previous versions to be accessed;
- Allow for collaborative work on content;
- Integrated document management systems;
- Workflow management - allowing for parallel content development; and
- Provide extensions and plug-ins for increased functionality.

(vi) Document Management Systems: Document management systems, as the name implies, are systems that aid in the publishing, storage, indexing, and retrieval of documents. Although such systems deal almost exclusively with explicit knowledge, the sheer volume of documents that an organisation has to deal with makes them useful and in some cases even mandatory. Often they are a part of content management systems.

Usually, a document management system will include the following functions: i) classification using metadata; (ii) indexing; (iii) searching and retrieval; (iv) capturing; and (v) versioning.

(a) Proposed climate change knowledge management system

In an effort to serve as a "one stop shop" for climate change related knowledge, information, data, and tools, use technology as the enabler of the climate change knowledge management strategy is recommended. The successful integration of scientific information in decision making often depends on the use of flexible frameworks, data, and tools that can provide comprehensive information to a wide range of users, allowing them to evaluate how to apply the scientific climate change information and knowledge in policy design and planning.

The aim of the ICT-based climate change knowledge management system is to help provide all the potential climate change knowledge users in Kenya with a resource to explore, evaluate, synthesise, and learn about climate-related vulnerabilities and risks at multiple levels of details. Using climate science research results to inform the decision making process

concerning policies or specific measures needed to tackle climate impacts, or even to understand low carbon development processes, appropriate use of technologies to lower carbon emissions, is often a difficult yet crucial undertaking.

The proposed Climate Change Knowledge Management (C2KM) system will contain environmental, disaster risk, and socio-economic datasets, as well as synthesised products such as climate adaptations, mitigation, climate change risks, which are built and packaged for specific user-focused functions such as climate change indices for a particular region. The C2 KM system will also provide intelligent links to other resources and tools.

If the data fed into the system is spatially referenced it can be visualised on a Google Maps interface. Users will be able to evaluate climate-related vulnerabilities, risks, and actions for a particular location in Kenya by interpreting climate and climate-related data at different levels of details. The key benefits of the system will include : (i) Learn about climate information;(ii) Increase knowledge on climate change related actions; and (iii) Map specific climate change knowledge.

The main purpose of C2KM is to initiate to establish and maintain an operational and functional technology-based climate change knowledge management system. This system, as pointed out earlier, will be a multi-sectoral and thematic knowledge management system (climate change) instead of an organisational knowledge management system for the CCS or the MEMR. In other words, it will be a system that will serve all the stakeholders involved in climate change including the CCS, MEMR, government agencies, NGOs, civil society and the private sector.

The C2KM will manage and integrate the following components or modules: metadata; multimedia knowledge products (audio, still images, animation, video); hazard maps; research results; best practices from projects; lessons learnt from projects; climate change documents (laws, policies, regulations, agreements), links to other climate change-related knowledge sources and learning modules.

(b) C2KM key functionalities

The envisioned C2KM system incorporates all the aspects of the technology-based knowledge management systems, that is, learning, sharing, collection, consolidation, and innovation. By use of SOA as a design and implementation strategy, the system is built in a phased approach, where successor phase uses the prior phase.

(i) Content management capabilities

Content management is very relevant to knowledge management since the functionality will be used for the creation, management, and distribution of content on the intranet, extranet, or a website. The content management module (CMS) is used for managing user blogs, forums, tagging, collaboration content, and wiki, among others.

(ii) Document management functions

Document management module of the systems will aid in the publishing, storage, indexing, and retrieval of various climate change documents or reports. This module will be used to manage explicit knowledge and can be part of the content management module. Core elements delivered by this module are documents classification using metadata, indexing, searching and retrieval.

(iii) RSS feed:

News feeds allow one to see the latest headlines from the websites relevant to the community in one place as soon as it is published and without having to visit the individual websites. The system will have the capability to consolidate data news and documents from other sites which are relevant to the climate change.

(iv) Data mining functions

Over time, the system should have capabilities to employ data mining and data warehouse techniques to enhance decision-making and solve problems by enabling multi-dimensional view of the stored knowledge.

(v) Metadata architecture

The term "meta" comes from a Greek word that denotes "alongside, with, after, next". Metadata, then, can be perceived as data about other data. A metadata record consists of a set of attributes, or elements, necessary to describe the resource in question. The linkage between a metadata record and the resource it describes may take one of two forms:

- Elements may be contained in a record separate from the item, as in the case of the library's catalogue record; or
- The metadata may be embedded in the resource itself.

Metadata capability of the system will be used to describe all the knowledge that will be integrated into the C2KM.

(vi) Advanced search

There will be one main search that will search through the whole system. This feature does not require one to refine the search parameter by selecting the category of the search item. There will be a search module in main pages such as organisation page, article page or case study pages as needed. Advances search will be used to enable the users to refine the search basis as the following:

- Specialists or experts;
- Organisations by different parameters e.g. location, names or specialisation; and
- Document author or name.

(vii) Content workflow engine

The Climate Change Knowledge Management System that should be able to support the approval and review process of the inbound climate change knowledge. Any climate change

knowledge that is to be integrated into the system must undergo a review by a group of experts to verify its relevance, correctness and source. This will ensure that only reviewed content is integrated into the C2KM system. A sample workflow to manage the upload of inbound climate change knowledge is depicted in Figure 5 below.

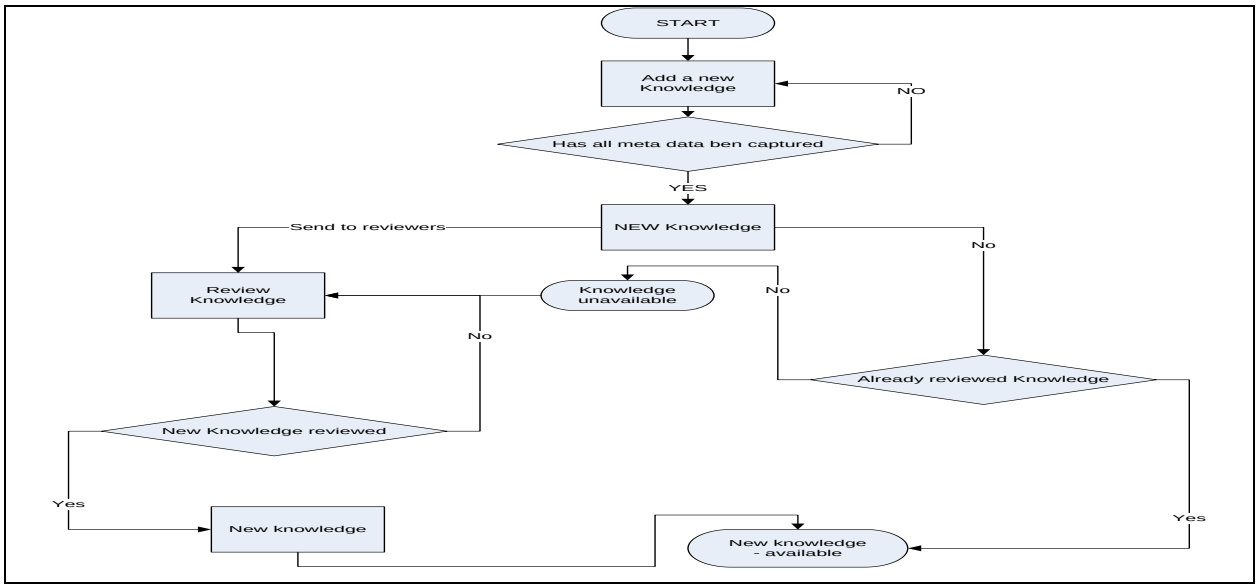

Figure 5: Sample workflow process

- **New** – Newly acquired knowledge not available to the end users;
- **Reviewed**– The new knowledge has been reviewed by volunteer experts;
- **Available knowledge** – The reviewed and accepted knowledge is made available by the administrator. This can now be accessed by users.

(viii) Artificial intelligence (AI) functionalities

It is envisioned that the final C2KM system will have AI functionalities that will perform pattern machining to assist in prediction of impact of convergence of certain climate change conditions. This will be done by learning from historical information.

(ix) Geographical information System (GIS) functionality

The C2KM in the end must provide a good visualisation of the information feed onto it. It is envisioned that at the top-end of implementation, users will be able to perform geographical analysis by applying statistical analysis and other informational techniques to geographically based data. This will be in form of animation or multi-dimensional view of related climate change information for a particular geographical area.

The envisioned C2KM system will have a GIS component that will be used to render visualisation of the geographically tagged information on maps. The system will be able to add multi-layering of different information to show a likely scenario when certain factors converge.

(x) Decision support functions

It is envisioned that the C2KM system will be used by some decision makers to assist in decision making. The C2KM system will therefore have the ability to combine various data and knowledge sets and feed the same into the system through SOA, data mining and content aggregation activities and present multiple dimensional view of this information. This will be a powerful differentiator from having each disparate system handling a subset of the knowledge.

At the top of the system, users will be able to extract decision support reports after consolidating data from different sources and creating different dimensions.

(xi) Automated alerts

Registered members in the system can opt to be notified via SMS or email when certain events occur such as when an article is added in the subscribed initiative. Alerts can also be broadcasted to everyone registered in the system via SMS or email. One will also be able to choose the alert frequency e.g. monthly, weekly, daily or hourly.

(xii) Protocol descriptions and Extraction, Transformation, Loading (ETL) Layer (Knowledge harvesters)

Most of the identified technology-based climate change knowledge systems are office-based or project-based legacy systems. In knowledge management system utilisation is self-perpetuating. Hence, several knowledge management systems are actively functioning and utilising different, non-interoperable platforms and standards. There are no plans to replace these or even perform data migration. The intention is to integrate these platforms without dismantling and supplanting them. The situation requires a solution that interfaces these fragmented systems without disrupting them.

We are proposing service-oriented architecture (SOA) instead of enterprise architecture as a design and development strategy. This strategy will provide for the auto-capture of specific knowledge residing in legacy systems. It will also enable the search and retrieval of knowledge products housed in other servers through metadata and middle ware. It will make knowledge harvesting from other websites possible. More importantly, it will facilitate evolutionary prototyping of the system itself by adding new digital knowledge sources as they are identified.

The protocol description will have a set of rules that describe how data housed in autonomous knowledge systems can be accessed by specifying access methods and forms.

(xiii) Knowledge sources

This is not functionality per se but a group of existing climate change knowledge systems that will be used as sources of the climate change knowledge. These will continue functioning as is or with enhanced capacity. The climate change knowledge management system will connect to these systems on a need-by-need basis to retrieve the requested knowledge by the users. These knowledge sources will include the knowledge management system hosted by KMD and T21 (Ministry of Planning), among others.

(xiv) SMS push and pull

The Kenyan mobile market t continues to thrive with mobile phone holders standing at around 28.08 million subscribers by the end of December 2011 (CCK, 2012). This means that close to 70 percent of Kenyans have mobile phones. Whereas most of these mobile phone numbers do not have data capabilities, they are used for sending SMS, a popular text-based service. This service apart from being used for peer to peer sending and receiving of SMS can also be used as an access channel for simplified climate change knowledge.

The strategy proposes to use this service to allow climate change information and knowledge management system to query and receive climate change knowledge. This functionality can also be used to crowd source climate change information and knowledge from the public with administrator moderating the content.

(c) Conceptual design framework for climate change knowledge management system

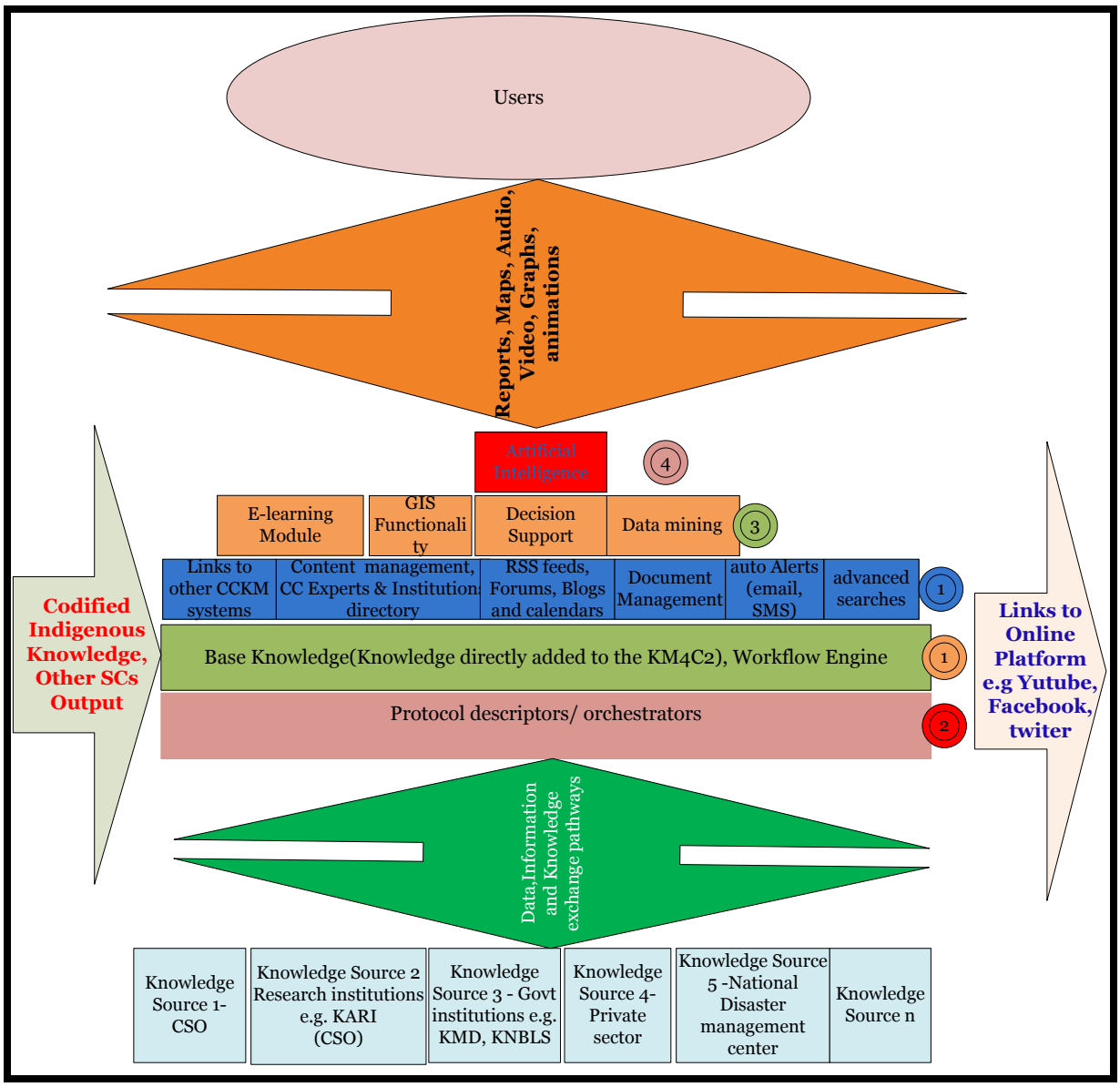

Figure 6: Climate Change Knowledge Management System Conceptual design model

(d) Implementation approach

An organisation's knowledge management system is the collection of information technologies used to facilitate the collection, organisation, transfer and distribution of knowledge between employees. Successful knowledge management projects use technological "building blocks" and take a phased approach that balances the immediate need to unify access to existing information with the long-term goal of improving the way knowledge is captured and managed.

Using this smooth "on-ramp" methodology to implement knowledge management makes the set of functional building blocks critical. Each block has to contribute to the ultimate knowledge management system, while providing a positive return on investment (ROI). In addition, each block provides immediate, beneficial results that can be seen by the entire organisation and each phase in the process provides a foundation used to implement the next phase.

The following table presents a summary of a phased approach using a smooth "on-ramp" methodology. Details about the building blocks used and recommended method of implementation are provided in each of the phases.

Table 2: A Phased implementation of C2KM

Phase	Goal	Technology blocks	Module	Recommended method of implementation
1	Quickly find people in climate change knowledge network who have specific climate change knowledge.	Climate change knowledge directory.	Content management	Implement knowledge directory module to automate the process of finding climate change experts or organisations involved in climate change activities.

2	Quickly improve ROI on existing knowledge assets.	Meta-level search broker and text-based electronic repositories with advanced search and retrieval capabilities	Advanced search, middleware	Implement meta-search module that accepts a single query from users, and then submits the query to internal climate change knowledge repository of multiple Internet and Intranet-based knowledge silos. Results from these silos are returned to the meta-search engine, which then orders and presents a single set of results to the user. For information that is focused and relatively homogeneous, implement a text-based electronic repository of the information with advanced search and retrieval capabilities. This provides immediate ROI and enables this silo for later inclusion in the
3	Enhance the process of locating applicable knowledge.	Knowledge mining module	Data mining module	Add knowledge mining module that allows query results to be sorted and clustered according to a set of pre-defined categories that are applicable to the target climate change problem.
4	Increase the accuracy and speed of classifying knowledge.	Automated categorisation functionality	Content management and document management modules	Implement automated categorisation module and apply it to knowledge in existing silos as well as in coming streams of new knowledge. These tools can be used to assist persons assigned to the task of knowledge classification by providing a preliminary "first cut" based on the contents of a knowledge source.
5	Provide substantially enhanced functionality, security, and performance for the growing knowledge management activity in the organisation.	Knowledge warehouses	Data mining module	Roll-out knowledge warehouses. Integrate existing knowledge silos by implementing the middleware rules that facilitate the harvesting of information and knowledge from various systems and present the feed back to the user. The original sources are not replaced but continue to update its knowledge independently. These changes are reflected on querying the knowledge by supplying applicable metadata.

6	Start capturing valuable "tacit knowledge" (Indigenous knowledge) that was previously lost. Make the contribution of knowledge easier and faster.	Forms-based contribution of knowledge assets	Content Management	Allow end-users to directly contribute knowledge to the knowledge warehouses. Create and deploy Internet or Intranet-based forms for the most often used types of knowledge assets. These forms provide a structured way to collect required metadata, to start capturing valuable "tacit knowledge". Example of forms include resumes, best practices, news articles, research notes or any other types of user-created or user-discovered knowledge.
7	Enable faster access to critical knowledge. Reduce the risks of not finding key information.	Knowledge mapping	Data mining module	Pre-build taxonomies ("knowledge maps") designed for specific tasks (e.g. adaptations) or regions (e.g. ASALs). Examine existing knowledge assets and those that have been contributed to the knowledge warehouse to identify the applicability of pre-configured taxonomies and to identify where existing taxonomies need to be augmented, simplified or eliminated. Connect these taxonomies with the forms implemented in phase 5 to assist in the rapid and accurate classification of new and existing corporate knowledge. Use more sophisticated versions of the knowledge mining tools implemented in phase 2 to quickly find key knowledge assets.
8	Enable spatial data visualisation.	GIS functionalities	GIS module	Implement mapping functionality to enable user visualise geo-coded data. These maps should have a capability of overlaying several datasets to create a multi dataset maps.
9	Enable potential users to use the platform to learn issues about climate change. Can be simple	E-learning function	E-learning module	Implement a learning curriculum that can be used by on-line learners on the issues about climate change. Can be simple learning module to a complex learning capability with certification.

	learning module to a complex learning capability with certification			
10	Enable prediction and learning.	Artificial intelligence	AI procedures	Implement artificial intelligence agents that learn the existing knowledge over time and produces new knowledge patterns.

2.5.2 Resource contributions by knowledge partners

The potential members of the climate change knowledge management network were asked to individually identify their agency's possible contributions to the climate change knowledge management system initiative in terms of content (virtual); Climate Change Knowledge Resource Centre (physical); and the climate change knowledge management system programmes (services).

Potential virtual content contributions range from digitized documents, publications, hazard maps, proceedings, news briefs, abstracts, and expertise for CoPs. Physical content contributions encompass climate change library (facility), publications, maps, and compilation of policies, laws, implementing rules and regulations, lists, equipment for the interpretive center, exhibits and others. Lastly, service contributions include security management, data warehousing, content development, library services, hosting services, climate change documentary shooting, and climate change animations among others.

Table 3: Sample matrix of virtual, physical and service contributions from possible Knowledge Partners

KNOWLEDGE PARTNER	SECTOR	VIRTUAL MODULES AND CONTENT CONTRIBUTIONS	PHYSICAL CONTENT CONTRIBUTIONS	SERVICE CONTRIBUTIONS
AAP	Environmental protection, Water and Housing.	All adaptation research papers		
Ministry of Lands	Agriculture and Rural Development.		Compilation/Lists of Policies for Land Administration and Management Lists of titled and untitled lots in the Kenya Manual/Publications on different kinds of land acquisition	
Ministry of Energy	Energy, Physical Infrastructure and ICT	Scientific research on renewable energy use.	GHG emissions Inventory Maps, Lessons learned from methane	
KMD	Environmental protection, Water and Housing.	Scientific research & studies-related to Climate Change e.g. Temperature collection, etc. Sea-level monitoring stations Rainfall patterns Analysis of past climate trends Climate projections Generation of climate information of all timescales Climate monitoring Forecasting extreme climate events	Scientific research & studies-related to Climate Change e.g. Temperature collection, etc. Sea-level monitoring stations Rainfall patterns Analysis of past climate trends Climate projections Generation of climate information of all timescales Climate monitoring Forecasting extreme climate events	

Ministry of Water	Environmental protection, Water and Housing.	Health Water and energy Water resources maps	Water resources maps	
All knowledge partners	Various	Lessons learned from implementing projects, climate change research work		
Kenya broadcasting Corporation	Energy, Physical Infrastructure and ICT			Climate change documentaries shooting.
ICT Board	Energy, Physical Infrastructure and ICT			climate change knowledge management system hosting (Physical) Data warehousing (Physical)
KNLS	Social protection, Culture and Recreation.			Library space in each county headquarters or where they have physical presence.
KCCWG	Various	• National adaptation techniques • Lessons learnt from implementing climate change projects • Lessons learnt in coming up with climate change laws in Kenya • Simple thematic researches done to inform climate change advocacy in specific sectors • Models of organizing successful climate change networks in some regions of Africa		

		• Best approaches to organize and receive information from communities to inform national and county processes		
National Museum	Social protection, Culture and Recreation.			Indigenous knowledge documentation.
KARI	Agriculture and Rural Development.	Climate change relevant publications and research work e.g. drought resistant crops Agriculture and food security	Climate change relevant publications and research work e.g. drought resistant crops	
Ministry of Livestock	Agriculture and Rural Development.	Livestock population and distribution	Livestock population and distribution	
Kenya Forestry Service	Environmental protection, Water and Housing.	Forest and biodiversity research reports		
Kenya Wildlife Services				
Ministry of Agriculture	Agriculture and Rural Development.	Food production and distribution		
Department of disaster management	Social protection, Culture and Recreation.	Climate-induced disasters		
Kenya Police	National security.	Conflict reports with location and period	Conflict reports with location and period	
Ministry of Transport	Energy, Physical Infrastructure	Urban development and infrastructure		

	and ICT.			
Ministry of Planning and Vision 2030	General Economic, commercial and Labour Affairs.	Impact of climate change on development priorities from T21		
NEMA	Environmental protection, Water and Housing.	Environmental related research work. Natural resource inventories and their use.		
Ministry of public works	Environmental protection, Water and Housing.	Sustainable Construction	Sustainable Construction	
Ministry of Environment and Mineral Resources	Environmental protection, Water and Housing.	Climate change Research work, Remote sensing data through DRSRS	Resource center, Hosting servers for C2KM	Coordination of the climate change knowledge network
CSO	Various	Climate change research work. Gender based climate change impacts research work.	Copies of research work	Knowledge and content authoring skills
Private Sector	Various	Energy efficiency research work. Carbon footprint baseline data. Environment protection initiatives	Copies of research work	Co-financing of climate related initiatives.

2.6 Monitoring and Evaluation 2013-2017

OBJECTIVE 1: ***Establish a National Institutional Arrangement for Climate Change Knowledge Management***

Activity	Timeline	Inputs	Responsible	Measure	Indicator
Develop an engagement plan with all stakeholders for developing a national policy on sharing climate change information and knowledge	2 Months	Budget Personnel	CCS	Documented engagement plan	- System accessibility - System utilisation - Frequency of updates
Validation of the DSA agreements	1 Month	Budget Personnel	CCS	Signed DSAs Increased national ownership and partnership building on climate change knowledge sharing	
Capacity development Recruitment of necessary personnel at the CCS such as Climate change expert; engagement team leader; IT Administrator; and library expert Training and benchmarking creation of focal points individuals as KM officers or specialists with continuous capacity development	6 Months	Budget	CCS	All the personnel recruited All the knowledge partners are trained and capacity developed to continuous push the generated knowledge into the network.	Central node well-staffed and functional Continuous flow of the knowledge through the climate change information and knowledge network.

opportunities					

OBJECTIVE 2: Develop and maintain a robust and up-to-date climate change knowledge management system

Activity	Timeline	Inputs	Responsible	Measure	Indicator
Systems Development Analysis and Design Testing and Evaluation Implementation	1.5 years	Budget Hardware Software Personnel	CCS	Operational and functional climate change knowledge management system with all envisioned modules developed	System accessibility System utilization Frequency of updates
Content Development Knowledge products design and development Knowledge harvest Metadata population	Continuous	Budget Hardware Software Dedicated Team	CCS and Knowledge partners	Increased sharing and reuse of climate change knowledge resources	GIS Analytics Updated Knowledge New knowledge products.
Capacity Development Training of all the core users on how to use the system.	1 year	Budget	CCS and Knowledge partners	Strengthened institutional capacity for climate change knowledge management system Improved organizational capacity for climate change knowledge management system	Participation rate Degree of project ownership Efficiency of climate change knowledge management system Program

Awareness of the functionalities of the system disseminated to the public				Improved quality of climate change knowledge management system and products Accelerated knowledge generation on climate change knowledge management system	Effectiveness of climate change knowledge management system system Quality of content and knowledge products Utilization of climate change knowledge management system

OBJECTIVE 3: Establish a climate change resource centre

Activity	Timeline	Inputs	Responsible	Measure	Indicator
Fund raising	Two Months	Justification and priority documents	CCS	Documented Plan	- Availability of funds
Identify the land where the center will be built.	One Month	- Budget - Personnel	CCS	Land available for the construction	Documented inputs from all the stakeholders and input to the national policy
Tender for the architectural designs.	Three Months	Budget Personnel	CCS	Architectural designs	Architect Identified, tender awarded and designs completed
Tender for the construction of the centre	One Month	Budget Personnel	CCS	Tender completed	Contract identified and tender awarded
Construction	One Year	Budget Personnel	Contractor	Construction Complete	Handover of the building to Climate Change Resource Centre

OBJECTIVE 4: Develop and implement a mechanism for monitoring the application of climate change knowledge by policy makers and people at the frontline of climate change impacts

Activity	Timeline	Inputs	Responsible	Measure	Indicator
Develop the measurement criteria e.g. number of users of the climate change knowledge management system, number of the knowledge partners signed into the network against the scoped institutions	2 Months	Budget Personnel	CCS	Measurement criteria developed	System accessibility System utilization Frequency of updates
Perform survey on the usage of the climate change information and knowledge from the network	Every 6 Months	Budget Personnel	CCS	Number of users using the climate change adaptation information and knowledge from the network.	Increased adaptive capability
Perform survey on the usage of the information and knowledge from the network by the policy makers	Every 6 Months	Personnel Budget	CCS	Number of policy makers using the climate change information and knowledge from the network.	Increased use of the climate change information and knowledge generated by the network by the policy makers
Perform survey to determine the coverage of usage of the adaptation techniques developed by the network and their usage	Every 6 Months	Personnel Budget	CCS	Number of users at the fore front of climate change impacts using the climate change information and knowledge from the network.	Increased adoption of the adaptation techniques developed in the network by potential user groups, including men, women and marginalized groups

Perform survey on the number of the knowledge products from the network and their usage	Every 6 Months	Personnel Budget	CCS	Number of the climate change information and knowledge products from the network.	Increased number of simplified climate change knowledge products for use by all categories of users

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[i] Kenya's Climate Change Action Plan: Mitigation, Chapter 6: Energy Demand, page 4
[ii] Kenya's Climate Change Action Plan: Mitigation, Chapter 6: Energy Demand, page 19