

Review of the National Disaster Management Policies and Plans of Kenya and Uganda

for Scoping Disaster Risk Reduction for Earth Observation

Project Title: Disaster Risk Resilience Scoping Project

UK Partners: Dr Sophie Hebden and Dr Nibedita S. Ray-Bennett

UK Partner Institution: NCEO University of Leicester

Document Prepared by: Denise Corsel, Nibedita Ray-Bennett and
Sophie Hebden

Date: 5 April 2017



Table of Contents

1. Introduction.....	3
2. Disaster Context.....	4
2.1 Kenya	4
2.1.1 Disasters.....	4
2.1.2 Disaster Management Structure.....	5
2.2 Uganda	7
2.2.1 Disasters.....	7
2.2.2 Disaster Management.....	8
3. Review of Kenya’s National Disaster Management Policy.....	10
4. Review of Uganda’s National Disaster Management Policy.....	16
5. Main Findings	22
5.1 Kenya’s ‘Needs’ for Earth Observation.....	22
5.2 Uganda’s ‘Needs’ for Earth Observation.....	24
6. Summary of Key Findings	25
References.....	27

List of Abbreviations

DAC	Development Assistance Committee
DM	Disaster Management
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EIA	Environmental Impact Assessment
EO	Earth Observation
ESA	European Space Agency
EWS	Early Warning System
GEO	Group on Earth Observations
NCEO	National Centre for Earth Observation
RS	Remote Sensing

List of Figures

Figure 1: Kenya’s Flood and Drought Prone Areas.....	5
Figure 2: Structure of Disaster Management Bodies in Kenya	6
Figure 3: Geohazards in Uganda.....	8
Figure 4: Uganda’s Disaster Management Institutional Structure.....	10
Figure 5: How EO can Assist with the Components of the Pre-Emergency Phase.....	26

List of Tables

Table 1: Scoping EO within Kenya's Disaster Management Policy.....	11
Table 2: Scoping EO within Uganda's Disaster Management Policy.....	17

1. Introduction

There is a dire need in the Horn of Africa to develop early warning systems (EWS) to mitigate the effect of disasters on lives, livelihoods and critical infrastructure. EWSs are pivotal to develop efficient and effective disaster response systems. By developing a network of key stakeholders from Africa and the UK, this *Disaster Risk Resilience Scoping Project* aims to study the extent to which earth observation can be exploited to enhance the existing EWSs, both scientific and indigenous. In doing so, the project aims to take the agenda of the UN's 'Sendai Framework for Disaster Risk Reduction 2015-2030' forward and identify how EWSs that are 'people centred' (Global Target G) can be developed.

In order to do so, it is important that this document provides an initial review of the National Disaster Management Policies and Plans of Kenya and Uganda to provide the context of Kenya and Uganda. This review explores where and how Earth Observation (EO) can be used for Disaster Risk Reduction (DRR) within the National Disaster Management Policies. The purpose of undertaking this review is for the *Disaster Risk Resilience Scoping Project*, which has the long-term objective of 'improved disaster risk reduction (DRR) for Development Assistance Committee (DAC) countries by integrating space based Earth Observation data, particularly focusing on the Horn of Africa'. The project's short-term objective is to exploit the international convening power of GEO (Group on Earth Observations), the National Centre for Earth Observation's (NCEO) role as UK GEO coordinators (funded by NERC National and Public Good) and NCEO's scientific expertise in using EO in the field of natural disasters. Focusing on countries in Africa, specifically Kenya and Uganda, is very important because as the Sendai Framework highlights that African countries need special attention and support because they are continuously facing disaster-related challenges and an increase of risks (UN, 2015a).

Using EO for DRR has the potential to improve Disaster Risk Management (DRM). On a national scale, this can best be done by identifying where EO can be used within a national disaster management plan or policy. WHO (2003) and Moe and Pathranarakul (2006) emphasise that it is highly recommended for every nation to have a national management plan or some form of master plan in place. A national disaster management plan is a detailed plan of action on how to manage overall disasters from a national perspective. The government generally is the one to create a national disaster management plan since it is their main responsibility to guarantee the protection and preparedness of its population at all times, including during the occurrence of a disaster (IFRC, 2000). It is vital to have effective disaster management plans in place because they have the ability of decreasing the risks that could produce a disaster by allowing for preparation, mitigation of the risks and by making the future less uncertain (Bonner, 2010).

To provide a review of the National Disaster Management Policies and Plans of Kenya and Uganda, this document will initially provide some background information on Kenya's and Uganda's disaster context. Subsequently, it will individually review both Kenya's and Uganda's National Disaster Management Policies in a systematic and methodological way. This review will mainly focus on how EO can be used to enhance the nations' EWSs. Thereafter, a brief analysis of the review's main findings will be provided. Additionally,

Kenya's and Uganda's 'needs' for EO to improve DRR will be identified based on the review's findings.

2. Disaster Context

Prior to reviewing the national disaster management policies of Kenya and Uganda, it is important to understand the disaster context in both the countries. Therefore, this section will briefly cover how disasters impact both Kenya and Uganda and which disaster management policies, networks and systems are in place.

2.1 Kenya

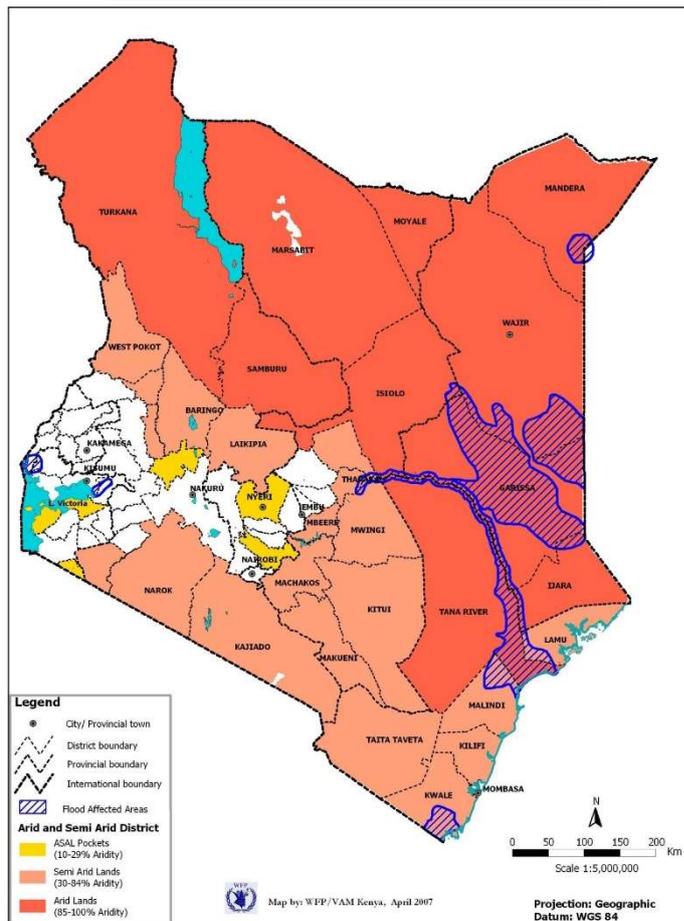
In Eastern Africa, Kenya is located on the edge of the Indian Ocean and between Somalia, Tanzania, Uganda, South Sudan and Ethiopia. It has a population size of 46,790,758 (CIA, 2016). Kenya's total area is 580,367 square kilometres and 48 per cent of Africa's land use is agricultural land (CIA, 2016). There are 47 administrative divisions in Kenya (CIA, 2016). Thus, there is a vast area where disaster management is important.

2.1.1 Disasters

According to Kenya's National Disaster Management Policy (Republic of Kenya, 2010: 2), Kenya is increasingly prone to a range of hazards and disasters and they "often affect the most vulnerable people disproportionately". It is ranked as the 20th country with the highest risk within the INFORM 2017 Risk Index (IASC, 2017). The INFORM Risk Index is a 'risk assessment for humanitarian crises and disasters' and assesses 191 countries. It is a collaboration of the Inter-Agency Standing Committee (IASC) Task Team for Preparedness and Resilience and the European Commission. INFORM partners include: UNISDR, UNDP, UNEP, UNFPA, UNHRC, OCHA, gfdrr, WFP, UNICEF, World Health Organization – amongst others. The higher the Risk Index number, the more at risk the country is. Kenya is highly at risk because of its exposure to hazards, its vulnerability and lack of coping capacity. Therefore, Kenya's disaster management required improvement. Kenya's National Disaster Management Policy agrees with this as they state that "[o]ver the years, disasters in Kenya have resulted in human suffering due to minimal or lack of preventive and mitigating measures put in place to minimize their effects" (Republic of Kenya, 2010: 2). Thus, the Policy aims to enhance the overall country's disaster management.

Kenya is especially prone to floods and droughts, which are seasonal hazards across Kenya. In fact, drought is "is the most common cause of humanitarian disasters and has a significant impact on the economy" (WFP, 2016). However, the national reported mortality due to disasters is higher for floods than drought; 71 per cent of the national reported mortality between the years 1990 and 2014 was due to floods (PreventionWeb, 2014). Please see **Figure 1** to see Kenya's flood and drought prone areas. Other natural disasters that impact Kenya but are less common are: earthquakes (e.g. in Nairobi in 2007); epidemics (e.g. Rift Valley Fever); extreme temperatures (often exceeding 40 degrees Celsius); insect plagues, mudslides (especially in Kenya's western area); high waves; and lightening (WFP, 2016).

Figure 1: Kenya's Flood and Drought Prone Areas



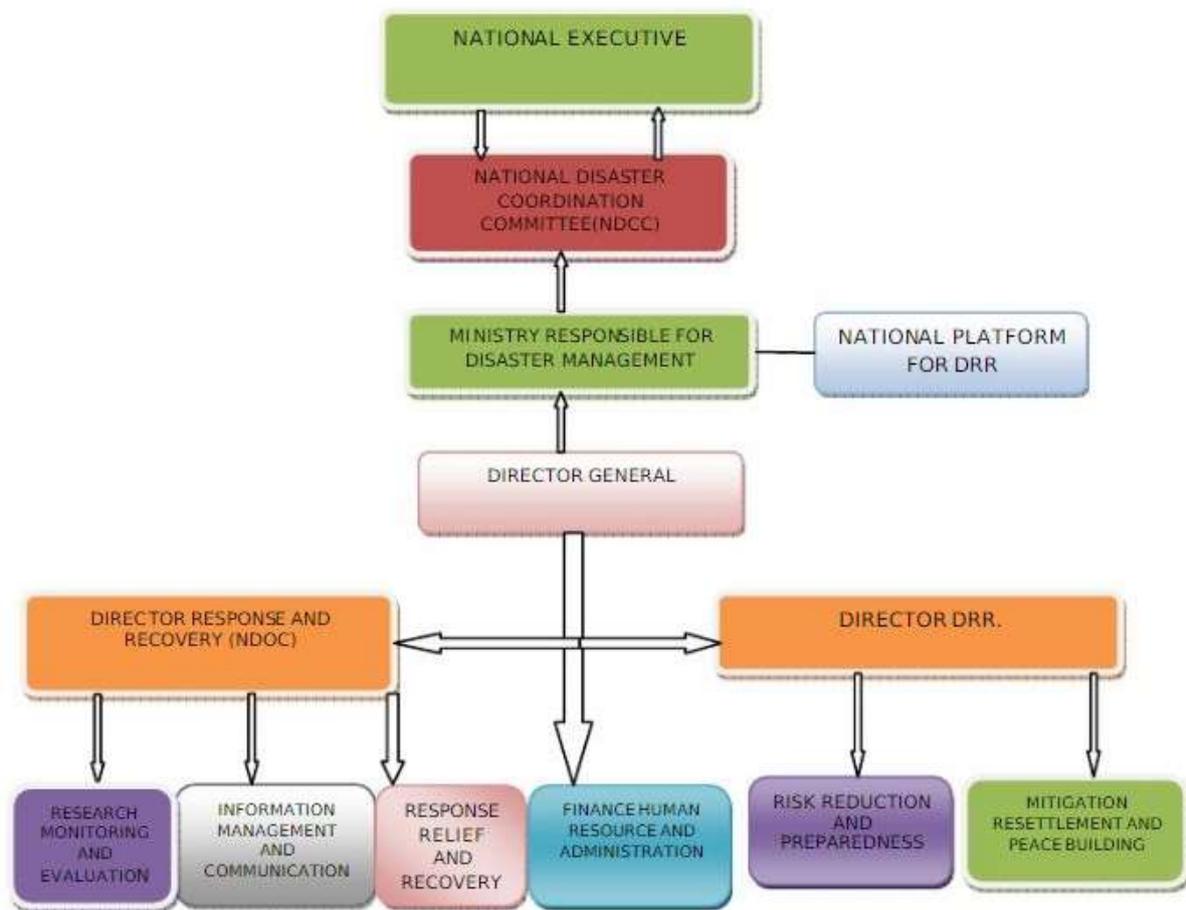
Source: (WFP, 2016).

2.1.2 Disaster Management Structure

According to Kenya's National Disaster Management Policy (Republic of Kenya, 2010), Kenya's disaster management structure in 2010 consisted of many different departments, committees and bodies. The *Ministry/Department Responsible for Disaster Management (MRDM)* is responsible for the formulation of disaster policies and the implementation of programmes, such as Disaster Risk Reduction Programmes (Republic of Kenya, 2010). The *National Disaster Coordination Committee (NDCC)* is mainly responsible for policy execution but it also provides disaster management information and guidance on ministerial plans. NDCC also is in charge of deploying national resources when a disaster or emergency strikes. The *Kenya National Platform for Disaster Risk Reduction (NPDRR)* involves the key stakeholders that are involved in disaster management. NPDRR's function is to bring together various actors from international organisations, private networks, and the government to share disaster management information and 'provide technical advice to higher level government decision-makers' (Republic of Kenya, 2010: 27). *National Disaster Management and Risk Reduction Directorates* is under the MRDM and consists a body of professional experts that have the 'authority to appropriately manage disaster prevention, mitigation and preparedness initiatives as well as response and recovery operations'

(Republic of Kenya, 2010: 28). The *National Disaster Operations Centre (NDOC) of Kenya* was set up in 1998 and acts as ‘the focal point for co-ordinating response to emergencies and disasters in Kenya’ (UN-SPIDER, 2015). NDOC’s responsibility is to monitor, assess and report all disasters on 24 hour and 7 day basis. This includes informing ‘the public on disaster related issues’ (Republic of Kenya, 2010: 33). Please see **Figure 2** for Kenya’s disaster management structure.

Figure 2: Structure of Disaster Management Bodies in Kenya



Source: (Republic of Kenya, 2010: 25)

According to the National Disaster Management Policy of Kenya (Republic of Kenya, 2010), NDOC is the lead agency/department responsible for the following hazards: earthquake, volcanic eruption, landslides, mudflows, rock falls and land subsidence. MRDM is the lead agency/department responsible for floods, tsunamis and cyclones. The ‘Ministry Responsible for ASALs Development’ is the lead agency/department responsible for drought, water shortage and food insecurity. Each of these lead agencies/departments have other support organisations. Please see Annex 4 of Kenya’s National Disaster Management Policy for more information on this.

In 2016, the National Drought Management Authority Act was established. This Act resulted in the National Drought Management Authority (NDMA). Due to the Act, the NDMA has the authority to “exercise overall coordination over all matters relating to drought management

including implementation of policies and programmes relating to drought management” (NDMA, 2017).

2.2 Uganda

In East-Central Africa, Uganda is located between Kenya, the Democratic Republic of Congo, Rwanda, South Sudan and Tanzania. It has a population size of 38,319,241 (CIA, 2016). Uganda’s total area is 241,038 square kilometres and 71 per cent of Africa’s land use is agricultural land, while 14.5 per cent is forest (CIA, 2016). There are 111 districts and 1 capital city, called Kampala, in Uganda (CIA, 2016).

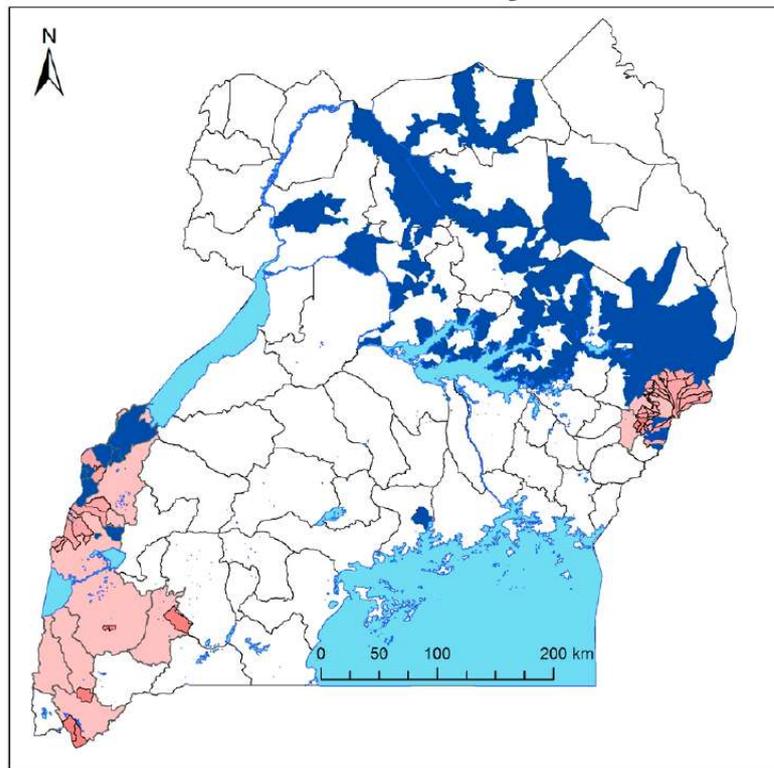
2.2.1 Disasters

Uganda, similar to Kenya, is increasingly exposed to hazards and disasters and this has had “grave consequences for the survival, dignity and livelihood of our citizens, particularly the poor” (Republic of Uganda, 2010: x). Uganda is ranked as the 23rd country with the highest risk within the INFORM 2017 Risk Index (IASC, 2017). “In the past two decades, on average more than 200,000 Ugandans were affected every year by disasters” (Republic of Uganda, 2010: x). Disasters continue to pose a national challenge. As such, Uganda’s disaster management is very important.

Within Uganda’s National Policy for Disaster Preparedness and Management (Republic of Uganda, 2010), drought is listed first within the Policy’s section on ‘Natural Hazards in Uganda’. Drought is connected to floods, which are both common seasonal disasters in Uganda. Flood is on the rise within many areas in Uganda because the areas “are continuously receiving less rainfall than before due to global warming and other deteriorating regional weather conditions” (Republic of Uganda, 2010: 6).

Another very common disaster in Uganda is landslide. In fact, 68.1 per cent of the national reported mortality between the years 1990 and 2014 was due to landslides, while only 10.8 per cent was due to drought and 9.6 per cent due to flood (PreventionWeb, 2014). Uganda’s government realises this and understands that landslides are difficult to predict and are often sudden. Thus, “working with local communities to relocate settlements to areas that are less prone to landslides” (WFP, 2015). Please see **Figure 3** to see the location of geo-hazard prone areas. Other disasters that sometimes occur in Uganda are: earthquakes, mudslides; insect infestation and volcanic eruptions (WFP, 2015).

Figure 3: Geohazards in Uganda



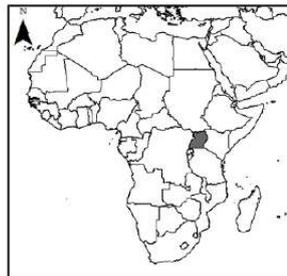
LEGEND

LANDSLIDE PRONE AREAS

- Recent Landslides on Subcounty level
- Landslide Prone Areas on District level
- Landslide Prone Areas on Subcounty level

FLOOD PRONE AREAS

- Floods on Subcounty level
- Lakes and rivers
- Uganda districts as of 2006



Source: (Staudt *et al.*, 2014)

2.2.2 Disaster Management

Uganda’s disaster management system involves many different key stakeholders (please see **Figure 4** for Uganda’s National Disaster Preparedness and Management Institutional Structure). Within the Office of the Prime Minister there is the *Department of Relief, Disaster Preparedness and Management*, which “is the lead agency responsible for disaster preparedness and management. It shall coordinate risk reduction, prevention, preparedness, mitigation and response actions in the country in consultation with other line ministries, humanitarian and development partners, Local Governments and the Private sector” (Republic of Uganda, 2010: 47). The Minister responsible for disaster preparedness and management reports to the President. Subsequently, the “President in consultation with

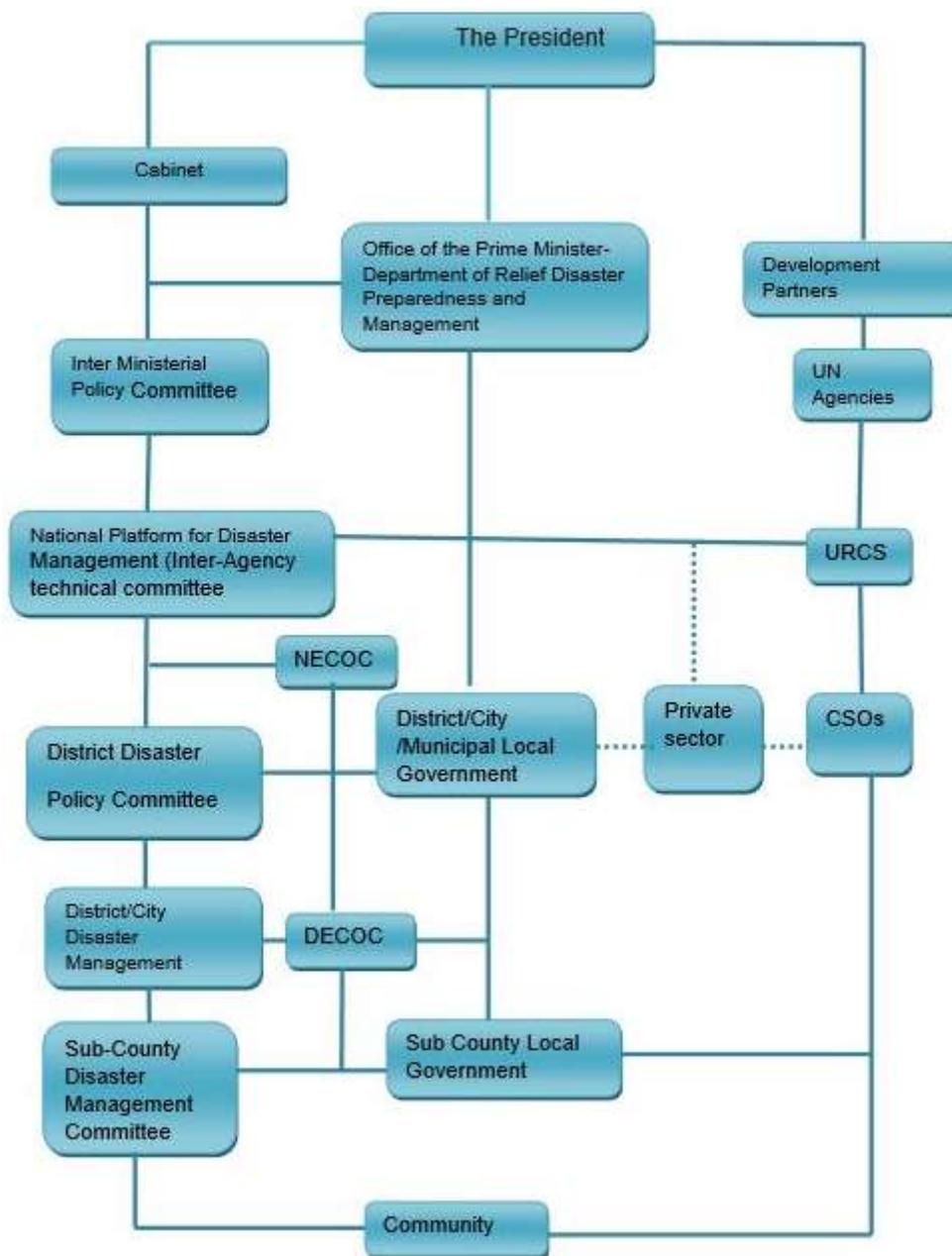
Cabinet shall declare an area or the nation to be in a state of disaster” (Republic of Uganda, 2010: 31).

The *Cabinet* is the body that produces government policy and provides advice to the President on disaster management. The standing committee of *Cabinet* is the *Ministerial Policy Committee (MPC)*, which “handle cross sectoral matters relating to disaster preparedness and management [... and ensures] that disaster preparedness and management is mainstreamed in the governance of Uganda” (Republic of Uganda, 2010: 32). According to Uganda’s Disaster Management Policy, an *Inter-Agency Technical Committee* will be formed, which will be “comprised of focal point technical officers from line ministries, UN agencies, NGOs and relevant stakeholders to be chaired by the Permanent Secretary of the Office of the Prime Minister” (Republic of Uganda, 2010: 33).

Uganda also has a *National Emergency Coordination and Operations Centre (NECOC)*, which deals with emergencies that have a sudden onset (e.g. landslides, floods, collapsed buildings, etc.). The *NECOC* “is responsible for the effective coordination and networking of the various emergency response institutions of government such as the fire brigade, Police Rapid Response Units, UPDF Emergency Support Units, Uganda Red Cross Society, hospitals emergency units and the private emergency firms” (Republic of Uganda, 2010: 35). The *NECOC* reports to the *Department of Relief, Disaster Preparedness and Management* and is “directly linked to the Uganda Police Operations Centre and all district police stations” (Republic of Uganda, 2010: 35).

At district levels, the Uganda Police would set up a *District Emergency Coordination and Operations Centre*, which would operate from the district police station and report to the *NECOC*. There will also be a *District Disaster Policy Committee (DDPC)*. In every city there will be a *City Disaster Policy Committee (CDPC)* and a *City Disaster Preparedness and Management Technical Committee (CDP&TC)*. The *CDPC* will be run by the City Mayor, while the *(CDP&TC)* will be run by the City Town Clerk (Republic of Uganda, 2010: 38). Furthermore, there will also “be a Municipal Disaster Policy Committee in every municipality of the country. There shall also be a Town Disaster Policy Committee in every Town Council in the country” (Republic of Uganda, 2010: 44). At village level, there will be a *Village Disaster Management Committee* to reach the local communities. The *Village Disaster Management Committee* is chaired by the chairperson the village’s Local Council and the other members of this committee will encompass all of the adult members of the village.

Figure 4: Uganda’s Disaster Management Institutional Structure



Source: (Republic of Uganda, 2010: 30)

3. Review of Kenya’s National Disaster Management Policy

Kenya’s National Disaster Management Policy started developing in 1999 and the more recent version was written in 2010 (Republic of Kenya, 2010). However, the National Disaster Management Policy is not finalised as it is still under development. Kenya does realise that a disaster management policy is needed. In 2015 at the UN’s World Conference on DRR in Sendai, Kenya’s President Uhuru Kenyatta promised that Kenya would scale up efforts to reduce disasters and mitigate risks (Kenya Daily Nation, 2015).

The ambitions of Kenya’s 2010 National Disaster Management Policy are:

- Prevention of disasters and their impact on families, infrastructure and the environment.
- Resiliency of families and communities by reducing vulnerability and increasing their ability to withstand and minimize the effects of disasters and complex emergencies including adaptation to climate change through increased preparedness.
- Response to disasters and complex emergencies that is fast, well coordinated, effective and appropriate.
- Recovery from disasters and complex emergencies that is timely, leaving communities and families in a better position to withstand future hazards.

(Republic of Kenya, 2010: 12).

These ambitions are holistic and support the country’s overall development. These ambitions can be achieved by following the policy. The policy’s foundation is based on comprehensive disaster risk management and an “all hazards” approach and thus, the above ambitions are in line with this.

The purpose of reviewing and analysing Kenya’s National Disaster Management Policy is to identify scopes for incorporating EO within DRR at national level. Additionally, this review will identify how geospatial and space-based technologies and related services can support national measures for DRR.

Table 1 identifies exactly where there is potential for EO within the National Disaster Management Policy. The text in the second column has been directly copied from the Framework and text that has been highlighted in grey indicates the most relevant aspects.

Table 1: Scoping EO within Kenya's Disaster Management Policy

Section	Context from the Disaster Management Policy	Potential for EO and This Project
<i>Guiding Principles</i>		
iv	Devolution and public participation. To promote a culture of accountability and transparency, the policy will enhance the participation of the public through devolution of resources and decision making especially to the vulnerable groups and those at risk in making decisions that affect them. The policy will be proactive in protecting and promoting the right of communities to manage their own affairs and further their own development especially the minorities and marginalized groups. Communities will be encouraged to establish mechanisms, building on their traditional coping strategies to share knowledge and technologies and to pool together local resources for disaster mitigation, preparedness, prevention, response and recovery.	<ul style="list-style-type: none"> - Public participation is very important for DRR, especially since the public is generally the ones ‘at-risk’. - By involving the public, the real ‘user needs’ can be identified. - When using EO for a DRM project, it is important that the public fully comprehends the information provided by EO techniques. - Building on the public’s traditional coping strategies is crucial in order to enhance the country’s EWS. - Knowledge and technologies (e.g. geospatial and space-based technologies) need to be shared.

v	Lesson learning and knowledge management: Over the last 15-20 years, considerable DM initiatives have been implemented in the country. In view of the experiences gained and lessons learnt during the management of the various hazards and disasters, the government will promote documentation and sharing of lessons with a view to continually improving best practices in DM.	<ul style="list-style-type: none"> - Previous DM initiatives that have used EO exist and thus, these initiatives can be learnt from and built on.
vi	Multidisciplinary and multi-sectoral approach: Disasters cut across disciplines and sectors; therefore, the government will promote adoption of an inclusive multi-disciplinary and multi-sectoral approach.	<ul style="list-style-type: none"> - Use of EO can contribute to being multi-disciplinary, especially if natural scientists, social scientists, the government and other organisations work together. - This project can aim to take on a multidisciplinary and multi-sectoral approach.
vii	Factoring of climate into disaster risk reduction: More than 70 per cent of natural disasters in Kenya are related to extreme climate events that are key causal factors for some emergencies that lead to disasters. The optimum factoring of climate/weather information (such as Early Warning, technical and scientific analysis) in disaster management is a vital component of this Policy. Climate Change will therefore be mainstreamed not only into DM, but also in overall Development Planning and Management.	<ul style="list-style-type: none"> - EO can assist with Early Warning of climate-related events (e.g. flood and drought). - Satellite imaging, radar and seismic probes can provide data that can be used to predict weather, overview natural resources and to respond to natural disasters.
ix	Research and dissemination of information: Research and information dissemination are critical components of effective DM. Therefore, all DM stakeholders have the responsibility of collecting, collating, documenting and disseminating their activities and experiences on disasters to other stakeholders. The MRDM (which is currently in-charge of disaster management in the country) will be a focal point for coordination and dissemination of research findings on disasters to stakeholders. The MRDM will therefore be designed to facilitate research as a key process for practical applications (within the department of Climate Change), and in association with strategic planning for overall DM.	<ul style="list-style-type: none"> - EO (geospatial information technology) can be used to disseminate risk information. - When disseminating EO data, it is important to disseminate it in a way that the public understands the data in order to ensure effective DM. - Our project may produce research findings and thus, this guideline should be respected.
x	Regional and International perspectives: Some hazards such as drought, epidemics, conflicts and proliferation of small arms are not confined within national borders. The government will promote linkages with regional and international institutions, in order to facilitate collaboration, e.g., in EWS, IGAD, CEWARN; and in fostering joint initiatives for DRR and response.	<ul style="list-style-type: none"> - EO data is not confined by borders - EO can be used to improve transboundary planning - This project promotes regional and international collaboration as it involves the cooperation of people in the scientific community, academia and the private sector at an international level.

		- Sharing EO data and enhancing cooperation between countries can be used to assist with this principle.
xii	Strengthening of Capacities for DM: Kenya has developed capacity for disaster management in stages. In view of the dynamic nature of disasters, the government and other stakeholders will continue to strengthen capacities through training, mentoring and skills development at all levels.	- EO can strengthen technical and scientific DM capacity, as well as capitalise on existing knowledge. - Providing RS and GIS training the government and other stakeholders would empower them and strengthen their capacities.
3.2.1 Role of the country governments in disaster risk management		
ii	Develop or strengthen disaster preparedness mechanism for effective response at community level including but not limited to establishing strategic stockpiles, contingency Planning, search and rescue, First Aid, disaster recovery planning among others.	- EO can be used to strengthen disaster preparedness mechanisms, which will enhance effective response at community level. - EO data can be used for risk assessments, exposure assessment, vulnerability assessment, hazard assessment, improving communities' preparedness to a disaster, hazard monitoring and responding to disasters more effectively.
iii	Develop disaster information data base, communication and dissemination strategy on county disaster risks and enhance early warning.	- EO can help the country's governments with developing a disaster information data base. - EO data can also be visually represented through maps, which can assist with the dissemination strategy of disaster information. - EO can be used to assist with multi-hazard forecasting and improving early warning systems by providing real-time monitoring.
4. Risk Reduction and Response Functions		
4.0	Risk awareness and assessment including hazard analysis and vulnerability/capacity analysis	- EO can help with the development of regional disaster risk assessments and maps, including climate change scenarios (Guo <i>et al.</i> , 2015) and vulnerability analysis.
4.0	Application of measures including environmental management, land-use and urban planning, protection of critical facilities, application of science and	- EO is geospatial and space-based technology that can be used to observe the earth, its environment and its climate.

	technology, partnership and networking, and financial instruments	- This project involves identifying how developing countries can be supported using science and technology, specifically EO but it focuses on the countries' specific needs and priorities.
4.0	Early warning systems including forecasting, dissemination of warnings, preparedness measures and response capacities.	- EO has a lot of potential to assist with EWSs as it can monitor and forecast the weather. Additionally, it can aid with producing warnings. For instance, flood warnings based on measuring precipitation and mapping out rivers/lakes. - EO can also improve response capacities. For instance, EO can identify the safest travel routes dependent on different types of hazards/disasters. Another example is that EO maps can assist with evacuating people living in disaster-prone area.
4.1	Identifying, monitoring and assessing disaster risks and enhancement of early warning	
4.1.1	Monitoring and analysis of disaster risks and vulnerability: Appropriate baselines and risk information is a vital component of DM. The information must be well linked to decision-making and the response system to ensure timely action. The MRDM in collaboration with key stakeholders will develop and maintain capacities and infrastructure to observe analyse and forecast hazards, vulnerabilities and disaster impacts through use of disaster maps and statistical loss information.	- EO involves monitoring the Earth's natural and manmade environment and collecting data in order to analyse and assess the current situation, any changes and historical trends. - EO can assist with environmental monitoring, meteorology, analysing disaster risks by making risk maps, and with undertaking vulnerability assessments.
4.1.2	People Centred-Early Warning: Providing early warning information on an impending disaster to population at risk in an appropriate manner helps to reduce the possibility of loss of life, injury, damage to property and environment and loss of livelihoods. A people centred early warning system will be developed with full participation of local people from both men and women.	- EO data can assist with enhancing early warning information. - EO can extensively map a localised area (potentially one that is difficult to access), identify vulnerable areas and be representative of the current situation. - When disseminating EO data, full participation of local people can be included. For instance, a mapping exercise with local men and women to

		combine their knowledge with satellite imagery.
4.1.2	Early warning information will be linked to risk identification, monitoring and analysis, dissemination and communication of risk information and disaster response capabilities.	
4.1.5	Disaster research: Disaster management requires capacity building for undertaking relevant research using appropriate technology. The policy recognizes the need for comprehensive research on disaster and their management in collaboration with local, regional and international learning and research institutions. The department responsible for DRR will support research on the nature of disaster risks, DM best practices and climate change adaptation and promote linkages with the relevant learning and research institution and disseminate research findings to stakeholders.	<ul style="list-style-type: none"> - The use of EO technologies is appropriate for disaster management. - EO can contribute to capacity buildings, as knowledge, awareness raising and training is required. - The use of EO will assist with gaining comprehensive research on disaster. - This project promotes linkages with the relevant learning and research institutions.
4.1.7	Environmental, Natural resource and land use Management: During relief and recovery operations all efforts will be made by all stakeholders in charge of DRR to prevent additional damage to the environment. A comprehensive environmental impact assessment will be required after the first stages of relief to guide rehabilitation, reconstruction and all the processes to recovery programmes to be implemented.	<ul style="list-style-type: none"> - EO can assist with undertaking a comprehensive environmental impact assessment (EIA), as well as with a damage assessment. - EO can also map areas that are less accessible to determine the damage created by the disaster. - EO satellite images can be used as a tool to conduct a damage assessment of different disasters (e.g. earthquakes, floods, volcanic eruption).
4.4	Disaster Recovery Processes: Recovery initiatives entail actions and programmes designed to help communities to return to normalcy or build back better. Effective disaster risk management requires that adequate attention be placed on helping communities recover from the effects of disasters in a way that leaves them more resilient and safe from future hazards and emergencies.	<ul style="list-style-type: none"> - EO can aid with building back better. - EO satellite images can be used as a tool to conduct a damage assessment of different disasters (e.g. earthquakes, floods, volcanic eruption). - EO can determine which construction material was resistant to the disaster. - EO can be used to identify 'safe' locations where infrastructure should be built. - EO can assist with sustainable urban planning by providing up-to-date spatial information about urban areas (Musakwa and Van Niekerk, 2014).

		<ul style="list-style-type: none"> - EO can also map agricultural land. - RS can be used to identify land contamination.
4.4.1	Early recovery focuses on stabilizing a disaster affected people, environment, area and ensuring that basic family needs for food, water, shelter and health are being met through increasingly self-sustainable means	<ul style="list-style-type: none"> - EO can map ‘safe’ places for shelter and to store food. - EO can identify where relief supplies should be sent to and how to get those supplies to the people and their shelters. - EO can identify the safest travel routes dependent on different types of hazards/disasters.
4.4.2	Long-term recovery emphasizes restoring infrastructure, systems and livelihoods to a pre-disaster state or better.	<ul style="list-style-type: none"> - EO can be used to identify ‘safe’ locations where infrastructure should be built. - To protect people’s livelihoods and environmental assets, it is first important to identify what they are. Through the use of EO, environmental assets and people’s livelihoods (farming, fishing) can be located.
4.4.2	Long-term recovery will also include a comprehensive EIA and a complete clean-up restoration of environmental and repair of any other environmental damage	<ul style="list-style-type: none"> - EO can be used as a tool to undertake an environmental impact assessment.
5. Decision-making, coordination & funding mechanisms		
5.3	Coordination, combined with good communication, is needed to successfully lead a disaster management organisation and the operational activities it undertakes. In the context of DM, coordination may be defined as bringing together the different elements of a complex activity or organisation into a harmonious and efficient relationship and to negotiate with others in order to work together effectively for the benefit of those affected by the event. [...] The NDMP will encourage and empower a culture of well structured DM systems and tools, supported and managed by carefully selected and trained human resources provided with appropriate, well sources material and equipment.	<ul style="list-style-type: none"> - EO can help with coordination planning. - EO can assist with risk-informed decision-making. - “Satellite data, particularly Earth observation data, can provide valuable, unique information supporting both research into natural hazards and their causes and operational decision-making tied to both planning and response” (CEOS, 2012).

4. Review of Uganda’s National Disaster Management Policy

Uganda’s National Disaster Management Policy was published in 2010 and was developed by having numerous consultations at all levels with key stakeholders, such as the public, rural villages, district authorities and stakeholders at national level (Republic of Uganda, 2010). This Policy’s “mission is to create an effective framework through which Disaster Preparedness and Management is entrenched in all aspects of development processes,

focusing on saving lives, livelihoods and the country’s resources” (Republic of Uganda, 2010: 2). While it’s “goal is to establish institutions and mechanisms that will reduce the vulnerability of people, livestock, plants and wildlife to disasters in Uganda” (Republic of Uganda, 2010: 2). This Policy advocates that a change needs to be made and that a new proactive approach to disaster management, which focusses on reducing risks, should be adopted. Additionally, this “approach involves a shift from a perception that disasters are rare occurrences managed by emergency rescue and support services. A shared sense of awareness and responsibility needs to be created to reduce risks in our homes, communities, places of work and society in general” (Republic of Uganda, 2010: 1).

Uganda’s Policy has seven key objectives to ensure that the Policy’s mission and goal will be achieved. These objectives are to:

- i. Establish Disaster Preparedness and Management institutions at national and local government levels.
- ii. Equip Disaster Preparedness and Management institutions and ensure that the country is prepared at all times to cope with and manage disasters.
- iii. Integrate Disaster Preparedness and Management into development processes at all levels.
- iv. Promote research and technology in disaster risk reduction
- v. Generate and disseminate information on early warning for disasters and hazard trend analysis
- vi. Promote public, private partnerships in Disaster Preparedness and Management.
- vii. Create timely, coordinated and effective emergency responses at national, district and lower level local governments

(Republic of Uganda, 2010: 2)

Using EO for DRR will especially assist with the Policy’s objectives: ii; iv; and v (see highlighted above). Using EO for object ii can be beneficial as it assists with equipping disaster preparedness and management institutions, as well as potentially building their DRM capacity. Additionally, EO can contribute to the institutions and overall country’s ability to be prepared at all times to cope with and manage disasters. Objective iv states that research and technology in disaster risk reduction should be promoted. Geospatial and space-based technologies, such as EO can be used for disaster reduction. In fact, the use of remotely-sensed EO for DRR is emphasised by the Sendai Framework. Thus, this is a good opportunity to assist with achieving this objective. Furthermore, objective v also has the potential to be benefitted from the use of EO as early warning systems for disasters and hazards can be improved with the used EO (e.g. for weather monitoring and forecasting).

Table 2 identifies specifically where there is further potential for EO within Uganda’s National Disaster Management Policy. The text in the second column has been directly copied from the Framework and text that has been highlighted in grey indicates the most relevant aspects.

Table 2: Scoping EO within Uganda's Disaster Management Policy

Section	Context from the Disaster Management Policy	Potential for EO and This Project
---------	---	-----------------------------------

Guiding Principles		
4	<p>Institutional Capacity Building: Effective Disaster Preparedness and Management shall be based constant reviewing and upgrading of institutional capacity to cope with disasters at national and community levels.</p>	<ul style="list-style-type: none"> - EO can strengthen technical and scientific capacity, as well as capitalise on existing knowledge. - EO can help with improving institutional capacity of the country to cope with disasters. - EO can also help with building infrastructure and drainage systems (e.g. to reduce flooding). - EO can be disseminated to national and community levels to improve their holistic understanding of coping with disasters, as EO can provide risk information. - EO can strengthen the capacity of local authorities to evacuate persons living in disaster-prone areas.
5	<p>Adequate Expertise and Technology: Disaster Preparedness and Management requires integration of technical expertise, indigenous and modern scientific knowledge on hazards and disasters in order to develop cost effective approaches for mitigation, preparedness, response and recovery. Government shall engage relevant expertise and appropriate technologies to come up with an effective disaster preparedness and management capability.</p>	<ul style="list-style-type: none"> - EO involves modern scientific knowledge and involves appropriate technologies that can aid effective disaster preparedness and management capability. - EO data can be strengthened with the use of indigenous knowledge on hazards and disasters. - EO can help with all the stages of a disaster: mitigation, preparedness, response and recovery.
6	<p>Vulnerability Analysis: Disaster preparedness and management depends on an accurate analysis and mapping of the vulnerability and susceptibility of communities to risks. It shall involve geo-referencing, mapping and livelihood zoning. Undertaking vulnerability analysis shall be part of the early warning system.</p>	<ul style="list-style-type: none"> - EO can be used as an excellent tool to analyse and map vulnerability and the susceptibility of communities to risks. - Technological measures, such as EO and GIS mapping of hazards, can be used to prevent and reduce hazard exposure and vulnerability to disaster. - The use of EO data and information can be used for conducting vulnerability assessments. - EO can improve the EWS.
10	<p>Regional and International Partnerships: This policy acknowledges that disasters transcend international borders and on this note, Uganda shall continue to subscribe to regional and international bodies related to disaster risk reduction. This policy shall</p>	<ul style="list-style-type: none"> - EO knowledge and the skill of using EO for monitoring, risk assessments and event/weather forecasting can be transferred from developed countries to developing countries, which

	promote participation in regional and global initiatives for the implementation of disaster risk reduction and response.	improves international partnerships. - This scoping project enhances international partnerships.
2.1.1 Drought		
2.1.1.1 Policy Actions on Drought	i. Establish proper mechanisms for weather predication, early warning and drought information message dissemination	- EO can definitely assist with this policy action.
2.1.1.1 Policy Actions on Drought	iv. Map and zone of drought prone areas and agricultural viable areas.	- EO will be able to assist with mapping drought prone areas and agricultural viable areas. Whereas, GIS software can be used to overlap these images to receive a clear understanding.
2.1.3 Floods		
2.1.3	... The risks of floods can be minimised forecasting, studying seasonal patterns as well as the construction and maintenance of sufficient drainage systems. Floods could be properly managed through flood plan mapping and surveys by air and land. ...	- Satellite images can be used by to identify weather trends, study seasonal patterns and forecast the weather based on current and historical EO data. - EO can assist with flood plan mapping. - EO can extensively map a localised area. This includes an area that may be difficult to access.
2.1.3.1 Policy Actions	iv. Ensure proper physical planning of rural and urban settlements.	- Effective use of EO can contribute to proper physical planning of rural and urban settlements. - EO can be used to identify flood-prone areas and distinguish where land is elevated. - EO can be used to identify 'safe' locations for reconstruction by determining where infrastructure should be built by distinguishing flood-prone areas, elevated land, where agricultural resources are, and by identifying land contamination. - EO can assist with sustainable urban planning by providing up-to-date spatial information about urban areas (Musakwa and Van Niekerk, 2014).

		- EO can be used to conduct land degradation assessments.
2.1.4 Landslides and Mudslides		
2.1.4	... Landslides and mudslides are very difficult to predict but their frequency and extent can be estimated by use of information on the area's geology, geomorphology, hydrology, climate and vegetation cover and traditional knowledge. ...	<ul style="list-style-type: none"> - EO has the potential for assisted with predicting landslides and mudslides through continuous monitoring and reviewing historical data/trends. - EO can be combined with traditional knowledge and the information of the area's geology, geomorphology, hydrology, climate and vegetation cover to improve the predictability ability.
2.1.4.1 Policy Actions	i. Gazette landslide and mudslide prone areas and prohibit settlement in such risk areas	<ul style="list-style-type: none"> - EO can be used to identify the risk areas. - EO can assist with identifying areas that are safe for human settlement. - A map can be created to show where these prohibited settlement areas should be.
2.1.8 Heavy Storms		
2.1.8.1 Policy Actions	v. Establishment of weather stations and early warning systems.	- EO can be used to improve the EWSs.
2.1.10 Earthquakes		
2.1.10.1 Policy Actions	i. Map out earthquake prone area	- EO can assist with mapping out earthquake prone areas.
2.1.10.1 Policy Actions	v. Undertake geological studies and research into earth movement	<ul style="list-style-type: none"> - EO can be used to monitor seismic activity and undertake vulnerability assessments. - Forecasting of the earth movement can be done based on monitoring of seismic activity, and historical information and observation.
2.24 Mines and Un Exploded Ordinance (UXOs)		
2.2.4.1 Policy Actions	i. Map out mine/ UXO contaminated areas	<ul style="list-style-type: none"> - A GIS database can be developed that includes UXO hazard and risk mapping. - An Overhauser magnetometer can be used for UXO detection. The Overhauser magnetometer is a tool for EO as it measures the Earth's magnetic field (Fan, <i>et al.</i>, 2016).
3.1.3.14 Village Disaster Management Committee		
3.1.3.14 iii	Use the early warning information to educate community members on risks and hazards that may potentially cause disaster	- EO can be used to improve early warning information.

		- It is important that EO data gets disseminated at village level.
5.0 Strategies and Mechanisms		
5.1.1	<p>Risk Assessment: Effective disaster preparedness and management depend on accurate information, projections and forecasts that are conducted with scientific precision. Government will procure relevant equipment both for effective monitoring and response. The equipment will include weather and tectonic forecasting equipment, ambulances and evacuation vans, firefighting equipment and safe water transport tanks, floaters, boats etc. Government will also establish a national disaster fund which will be replenished annually in accordance with the results of the risk assessments and research centres.</p>	<ul style="list-style-type: none"> - EO can assist with conducting risk assessment. - EO can provide accurate information, projections and forecasts. - EO is an effective monitoring and response equipment.
5.1.5	<p>International Partnerships and Co-operation: Some disasters have a cross border dimension. The existing and ongoing initiatives under the African Union, IGAD and East African Community are recognised by this policy. Therefore, the Government of Uganda shall form partnerships and collaboration mechanisms with regional forecast centres to enhance exchange of relevant information and national disaster preparedness capacities.</p>	<ul style="list-style-type: none"> - EO can assist with reducing the cross border dimension. - A shared database of information can be created among international partners. - A shared GIS platform can be developed to enhance the cooperation for disaster risk reduction. - EO can prioritise the most hazard-prone areas that may be transboundary or hazard-prone areas affected by a different area (e.g. a dam may be in one country which affects the water flow of a river in its neighbouring country).
5.1.7	<p>Early warning is a prerequisite for a successful Disaster Preparedness and Management interventions and it is the foundation upon which other efforts can be undertaken. The government and all other stakeholders will ensure that relevant, reliable, up-to-date and timely information is provided to the community.</p>	<ul style="list-style-type: none"> - EO can provide timely and up-to-date information. - EO can improve early warning; however, it is only a predictive tool, which means that it may not always be accurate.
5.1.10	<p>Gazetting Disaster Prone Areas: Government will come up with national risk, hazard and disaster profiles and maps of the country depicting each of the known natural and human-induced disasters. The profiles and maps will be updated at least once every 3 years. The national risk, hazard and disaster profiles and maps shall be produced and reproduced in sufficient quantities for distribution to reach all disaster prone Local Governments and village communities.</p>	<ul style="list-style-type: none"> - EO can assist with creating baseline maps, national risk, hazard and disaster maps. - EO data/information can contribute to disaster profiles.

5.1.12	<p>Resource Mobilization: The ministry responsible for disasters and all ministries shall secure adequate resources to implement disaster preparedness and management activities.</p>	<ul style="list-style-type: none"> - EO can identify/map the location of the shared resources and identify how to get the resources to the people. - EO can identify where relief supplies should be sent to and how to get those supplies to the people and their shelters. - EO can identify the safest travel routes dependent on different types of hazards/disasters. - EO can map the environmental and natural resources, which can strengthen the management approaches that incorporate disaster risk reduction.
--------	--	---

5. Main Findings

From the above review of Kenya’s and Uganda’s National Disaster Management Policies, it has been discovered that there is potential to integrate EO into both National Disaster Management Policies and into the countries’ disaster management system. Integrating EO into these Policies would support the Policies’ objectives, as well as enhance the countries’ disaster management, DRR and their capabilities. The use of EO has the scope to improve all the phases of a disaster: i) pre-emergency; ii) emergency; and iii) post-emergency. Furthermore, from the above review a few of Kenya’s and Uganda’s ‘needs’ for EO to improve DRR within their Policies were identified.

5.1 Kenya’s ‘Needs’ for Earth Observation

From the above review of Kenya’s Disaster Management Policy, it was seen that there is a clear potential for the use of EO for improving DRR. However, as one of Kenya’s Policy’s Guiding Principles highlights: ‘the policy will enhance the participation of the public through devolution of resources and decision making especially to the vulnerable groups and those at risk in making decisions that affect them’. Therefore, public participation is very important to identify the real EO ‘user needs’.

Furthermore, the above review discovered that within the ‘pre-emergency’ phase of a disaster there is a ‘need’ for EO to:

- Be used in combination of the public’s traditional coping strategies.
- Improve the country’s EWSs, especially for the early warning of flood and drought.
- Monitor and predict the weather.
- Assist with multi-hazard forecasting.
- Help with the development of regional disaster risk assessments and maps.
- Monitor and analyse disaster risks and vulnerability.
- Observe, analyse and forecast hazards, vulnerabilities and disaster impacts through use of disaster maps and statistical loss information
- Be a part of a multidisciplinary and multi-sectoral approach to disaster management.

- Help the country's government authorities with developing a disaster information data base.
- Aid with disseminating risk information. Additionally, understandable and tailored dissemination of EO data/information is important
- Strengthen the country's capacities for disaster management. EO can strengthen technical and scientific DM capacity, as well as capitalise on existing knowledge. Additionally, by providing RS and GIS training the government and other stakeholders would empower them and strengthen their capacities.
- Strengthen the country's disaster preparedness mechanism for effective response at community level.
- Be used for risk assessments, exposure assessment, vulnerability assessment, hazard assessment, improving communities' preparedness to a disaster, hazard monitoring and responding to disasters more effectively.

Additionally, within Kenya's Policy, it was seen that within the '**emergency**' phase of a disaster there is a 'need' for EO to:

- Determine the allocation of vital resources (e.g. money, infrastructure and man power).
- Identify the safest travel routes dependent on different types of hazards/disasters.
- Assist with evacuating people living in disaster-prone area by developing EO maps.

Within the '**post-emergency**' phase of a disaster there is a 'need' for EO to:

- Aid with recovery of disasters (both early recovery and long-term recovery)
 - Early Recovery
 - EO can help with coordination planning and can assist with risk-informed decision-making.
 - EO can map 'safe' places for shelter and to store food.
 - EO can identify where relief supplies should be sent to and how to get those supplies to the people and their shelters.
 - EO can identify the safest travel routes dependent on different types of hazards/disasters.
 - Long-term Recovery
 - EO can be used to identify 'safe' locations where infrastructure should be built.
 - To protect people's livelihoods and environmental assets, it is first important to identify what they are. Through the use of EO, environmental assets and people's livelihoods (farming, fishing) can be located.
- Undertake environmental, natural resource and land use management (e.g. by conducting a comprehensive environmental impact assessment).

Furthermore, as discovered from the reviewed conducted on the Sendai Framework for this project, EO can also be used to contribute to the Sendai Framework's Priority 4: Enhancing Disaster Preparedness for Effective Response and to "Build Back Better" in Recovery, Rehabilitation and Reconstruction. Kenya's National Disaster Management Policy also

emphasises this Priority and highlights that recovery initiatives should entail actions and programmes designed to help communities to return to normalcy or build back better.

5.2 Uganda's 'Needs' for Earth Observation

Within Uganda's National Disaster Management Policy there are many possibilities to incorporate EO to improve Uganda's disaster management and DRR. Specifically, from the review of Uganda's Policy it was discovered that incorporating EO could aid the Policy's Actions, such as the advocated actions on drought, floods, landslides, mudslides, heavy storms, earthquakes and mines/UXOs. The use of EO for disaster management is still an emerging field but there is a lot of potential. For instance, using EO for predicting drought or for mapping UXO contaminated areas still requires a lot more research. Nevertheless, the review has identified some of Uganda's 'needs' for EO to improve DRR within its National Disaster Management Policy. These 'needs' are listed below in connection to the three different phases of a disaster.

Within Uganda's Policy, it was seen that within the '**pre-emergency**' phase of a disaster there is a 'need' for EO to:

- Assist with upgrading the country's institutional capacity to cope with disasters at national and community levels.
- Improve the integration of technical expertise, indigenous and modern scientific knowledge on hazards and disasters.
- Analyse and map vulnerability and the susceptibility of communities to risks.
- Improve the EWS
- Assist with geo-referencing, mapping and livelihood zoning.
- Map and zone of a variety of disaster-prone areas and agricultural viable areas.
- Forecast, monitor and study seasonal patterns, as well as the construction and maintenance of sufficient drainage systems.
- Predicting natural hazards through continuous monitoring and reviewing historical data/trends.
- Identify areas that are safe for human settlement.
- Provide accurate information, projections and forecasts.
- Assist with reducing the cross border dimension.
- Produce national risk, hazard and disaster profiles and maps.

The review of the policy indicated that within the '**emergency**' phase there is a 'need' for EO to:

- Provide timely and up-to-date information.
- Identify/map the location of the shared resources and identify how to get the resources to the people.
- Identify where relief supplies should be sent to and how to get those supplies to the people and their shelters.
- Determine the safest travel routes dependent on different types of hazards/disasters.

Within the '**post-emergency**' phase of a disaster there is a 'need' for EO to:

- Contribute to proper physical planning of rural and urban settlements.

- Identify ‘safe’ locations for reconstruction by determining where infrastructure should be built by distinguishing flood-prone areas, elevated land, where agricultural resources are, and by identifying land contamination.

6. Summary of Key Findings

Both Kenya’s and Uganda’ Disaster Management Policies highlight that indigenous, traditional and the communities’ knowledge is important. In terms of EO, this can also be the case as EO data can be strengthened with the use of this type of knowledge on hazards and disasters. Additionally, EO can be combined with traditional knowledge and the information of the area’s geology, geomorphology, hydrology, climate and vegetation cover to improve the country’s predictive ability. Therefore, communicating with the at-risk community and the public is crucial. This will also help with identifying the real ‘needs’ for EO to improve DRR.

The concept of livelihoods is also emphasised in both Policies. Disasters can affect the public’s lives, health, shelter and livelihoods. By improving the countries’ EWSs, the effects of disasters can be reduced. Kenya’s Policy that: “Providing early warning information on an impending disaster to population at risk in an appropriate manner helps to reduce the possibility of loss of life, injury, damage to property and environment and loss of livelihoods” (Republic of Kenya, 2010: 41). While Uganda’s Policy has a guiding principle of ‘Vulnerability Analysis’, which states that the analysis and mapping of vulnerability should “involve geo-referencing, mapping and livelihood zoning” and that vulnerability analysis should “be part of the early warning system” (Republic of Uganda, 2010: 3).

Moreover, both Policies express a need for improved EWSs, especially for the early warning of flood and drought. Early warning occurs in the ‘pre-emergency’ phase of a disaster and is vital to reduce and mitigate the consequences of disaster, especially natural disasters that are generally not preventable. The ‘pre-emergency’ phase includes the following components: prevention, mitigation, preparedness and risk assessment(s). During this phase, EO can be beneficial in a variety of ways and can assist with each of the components of this phase (see **Figure 5**).

Figure 5: How EO can Assist with the Components of the Pre-Emergency Phase

<p>Pre-Emergency Phase</p> <p>Prevention</p> <ul style="list-style-type: none">* Pre-emptive monitoring and prediction through EO.* Improve and support the current early warning system.* Full prevention is generally not possible with natural disasters. <p>Mitigation</p> <ul style="list-style-type: none">* Enhance technical expertise and scientific knowledge.* EO can measure flood extent and flood depth.* Disaster mapping and weather forecasting with the use of EO. <p>Preparedness</p> <ul style="list-style-type: none">* EO can help create DM plans.* EO can assist with sharing info to the people and create a better understanding.* EO can help with capacity building.* EO can contribute the meteorological data.* EO can identify where the ‘safer’ areas are in terms of elevation and in relation to where the rivers are.* Remote sensing of soil moisture. <p>Risk assessment</p> <ul style="list-style-type: none">* EO can assist with undertaking hazard, risk and environmental assessments.* EO can map and zone disaster-prone areas and combine it with other knowledge (e.g. geographical landscape, agricultural areas, elevated land, location of health centres, safe routes, etc.)* EO can produce disaster maps and profiles of areas.* EO can map the geographical areas to see where the ‘safe’ and higher levels are, as well as where the risks may be.

The use and benefits of EO needs to be further explored, especially in terms of improving EWSs, taking account of livelihoods, and ensuring that the public’s real ‘needs’ and knowledge is listened to. To do so, this project will undertake a user need assessment for each of the countries by holding a workshop and by starting initial conversations with key stakeholders.

References

- Bonner, A. (2010). *An Ounce of Prevention: Navigating Your Way Through Damage Control and Crisis Response*. Edmonton: Sextant Publishing.
- CIA (2016). *The World Factbook*. Central Intelligence Agency. Available at: <https://www.cia.gov/library/publications/the-world-factbook/geos/ke.html> [accessed 29 March 2017].
- Fan, S., Chen, S., Zhang, S., Guo, X. and Cao Q. (2016). 'An improved Overhauser magnetometer for Earth's magnetic field observation'. *Proc. SPIE 9972*, Earth Observing Systems XXI. Conference Volume 99721N. Available at: <http://proceedings.spiedigitallibrary.org/proceeding.aspx?articleid=2554448> [accessed 6 April 2017].
- Guo, H., Zhang, L. and Zhu, L. (2015). 'Earth observation big data for climate change research'. *Advances in Climate Change Research*. 6 (2): 108-117. Available at: <http://www.sciencedirect.com/science/article/pii/S1674927815000519> [accessed 17 February 2017].
- IASC (2017). *INFORM Country Risk Profiles for 191 Countries*. Available at: <http://www.inform-index.org/Countries/Country-profiles> [accessed 29 March 2017].
- IFRC (2000). 'Preparedness planning'. *Disaster Preparedness Training Program*. June. Available at: <https://www.ifrc.org/Global/Preplan.pdf> [accessed 29 March 2017].
- Kenya Daily Nation (2015). 'We do need a disaster management policy'. *ReliefWeb*. Available at: <http://reliefweb.int/report/kenya/we-do-need-disaster-management-policy> [accessed 29 March 2017].
- Moe, T. and Pathranarakul, P. (2006). 'An integrated approach to natural disaster management'. *Disaster Prevention and Management: An International Journal*. Vol 15 (3): 396-413. Available at: www.emeraldinsight.com/0965-3562.htm [accessed 29 March 2017].
- Musakwa, W. and Van Niekerk, A. (2014). 'Earth observation for sustainable urban planning in developing countries: Needs, trends and future directions'. *Journal of Planning Literature*. 30 (2): 149-160. Available at: <http://journals.sagepub.com/doi/full/10.1177/0885412214557817> [accessed 16 February 2017].
- NDMA (2017). 'About NDMA'. *NDMA: National Drought Management Authority*. Available at: <http://www.ndma.go.ke/features/about-ndma> [accessed 29 March 2017].
- PreventionWeb (2014). *Kenya: Disaster & Risk Profile*. Available at: <http://www.preventionweb.net/countries/ken/data/> [accessed 19 March 2017].

Republic of Kenya (2010). *National Disaster Management Policy of Kenya (Final Draft)*. October 2010. Nairobi: Republic of Kenya. Available at: <https://www.scribd.com/doc/136662332/National-Disaster-Management-Policy-of-Kenya-Final-Draft-Oct-2010> [accessed 3 March 2017].

Republic of Uganda (2010). *The National Policy for Disaster Preparedness and Management*. October 2010. Kampala: Directorate of Relief, Disaster Preparedness and Refugees, Office of the Prime Minister. Available at: <http://www.ifrc.org/docs/IDRL/Disaster%20Policy%20for%20Uganda.pdf> [accessed 3 March 2017].

Staudt, M., Kuosmanen, E., Babirye, P. and Kedi, V. (2014). 'Production of multi-geohazard maps for Uganda geological mapping project'. *Special Paper – Geological Survey of Finland*. November. Available at: https://www.researchgate.net/figure/273136521_fig3_Fig-3-Preliminary-map-of-the-occurrence-of-geohazards-landslide-and-flood-prone-areas [accessed 12 March 2017].

UN (2015a). *Sendai Framework for Disaster Risk Reduction 2015-2030*. Geneva: UNISDR. Available at: <http://www.unisdr.org/we/coordinate/sendai-framework> [accessed 10 February 2017].

UNISDR AF (2004). *Africa Regional Strategy for Disaster Risk Reduction*. Ethiopia: African Union (AU), New Partnership for Africa's Development Planning and Coordinating Agency (NEPAD), African Development Bank (AfDB) and United Nations Office for Disaster Risk Reduction - Regional Office for Africa (UNISDR AF). Available at: <https://www.unisdr.org/we/inform/publications/4038> [accessed 10 March 2017].

UN-SPIDER (2015). 'Kenya National Disaster Operations Centre (NDOC)'. *United Nations Office for Outer Space Affairs (UN-SPIDER) Knowledge Portal*. Available at: <http://www.un-spider.org/links-and-resources/institutions/kenya-national-disaster-operations-centre-ndoc> [accessed 10 March 2017].

WFP (2015) 'Uganda Humanitarian background'. Logistics Capacity Assessment. Available at: <http://dlca.logcluster.org/display/public/DLCA/1.1+Uganda+Humanitarian+Background> [accessed 29 March 2017].

WFP (2016) 'Kenya Humanitarian background'. Logistics Capacity Assessment. Available at: <http://dlca.logcluster.org/display/public/DLCA/1.1+Kenya+Humanitarian+Background> [accessed 29 March 2017].

WHO (2003). *Surgical Care at the District Hospital*. Malta: World Health Organization (WHO). Available at: <http://www.who.int/surgery/publications/en/SCDH.pdf> [accessed 29 March 2017].