UNIVERSITY OF NAIROBI

EFFECT OF DROUGHT EARLY WARNING SYSTEM (DEWS) IN DROUGHT MITIGATION AND MANAGEMENT IN ARID AND SEMI ARID LANDS (ASALs) IN KENYA

MATHEW TUITOEK
P54/85500/2016

SUPERVISOR
DR. AGNES WAUSI

A RESEARCH PROJECT SUBMITTED IN PARTIAL FULFILMENT FOR MASTERS OF SCIENCE DEGREE IN INFORMATION TECHNOLOGY MANAGEMENT, UNIVERSITY OF NAIROBI

DECLARATION

This research project is my original work and has not been presented for a degree award in any other University.

Signed…………………………………...................…… Date…………………………

Mathew C. Tuitoek
P54/85500/2016

DECLARATION BY SUPERVISOR

This research project has been submitted for examination towards fulfilment for the award of Masters of Science Degree in Information Technology Management with my approval as the university supervisor.

Signed………………………………………………… Date.................………………

Dr. Agnes Wausi

DEDICATION

This research project is dedicated to my late Father, Joshua Tuitoek Chepchieng who believed in me and taught me the values of life, respect, integrity and hard work. To my Mum who taught me to simply stand up when I fall, be good to people, and always encouraged me to work hard and achieve my dreams. My wife Faith Kiptoo and my Kids Michelle, Myles and Kayden for their sacrifice, love, peace of mind and support that they accorded me during my research.

I also dedicate this research to my friends and classmates who gave me support throughout the process. Not forgetting future researchers in the area of drought mitigation and management. May the almighty God bless you abundantly.

ACKNOWLEDGEMENTS

I give thanks to the almighty God for his grace, strength and unending love and all those people who contributed tirelessly towards completion of this proposal in one way or another. Special thanks to my supervisor Dr. Agnes Wausi whose advice at different levels made this research project a reality. I thank her for always being there to offer her guidance even when so busy with other responsibilities.

I give thanks to my family who persistently stood by my side when I barely had enough time for them as I dedicated most of my time to this course. The understanding and support was a significant one towards achieving this success. I am also indebted to NDMA staff, my classmates and work colleagues for their support while doing this study.

ABSTRACT

Kenya is a drought prone nation with just 20.0% of the area receiving high, regular rains, and the other 80.0% is either arid or semi-arid land (ASAL). There are 23 ASAL in Kenya, out of which 9 of them are arid and 14 are semi-arid lands. One of the most crucial strategies to mitigate drought is the use of Drought Early Warning System which enables availing timely and reliable facts, via selected institutions like NDMA in Kenya that allow people who are exposed to the hazard to obtain action to circumvent or reduce the risk and be ready for useful response.

The study used a descriptive research design, which adopted a survey. Purposive sampling was utilized to get 5 respondents from the 23 ASALs totaling 115. Online Questionnaires were used as the primary method of collecting data. Data gathered were coded and analysed through the use of Statistical Package for Social Sciences (SPSS) to determine frequency distributions, rankings and correlations. The findings were presented in tables and charts. The findings established that the DEWS being a critical component of drought mitigation has enabled provision of timely and up to date information. This resulted to the conclusion that DEWS can minimize drought peril by ensuring on time response to drought threats. The study has also established that some Counties do not have capacity in terms of personnel to properly coordinate drought mitigation efforts.

The study recommends more capacity building on the DEWS as a drought mitigation strategy to ensure opportune planning for drought and to make sure there is efficient coordinated reaction by all relevant stakeholders. There is also need for NDMA to improve the DEWS to enhance information dissemination and collaborate with stakeholders to create awareness to communities living in ASALs. This will reduce risks associated with drought.

Keywords: ASALs, Drought, DEWS, NDMA

Table of Contents

Table of Figures

List of Tables

LIST OF ABBREVIATIONS AND ACRONYMS

ASALs	Arid and Semi-Arid Lands
CCMDRR	Community Managed Disaster Risk Reduction
DRM	Disaster risk management
DEWs	Drought Early Warning System
DRR	Disaster Risk Reduction
DCFs	Drought Contingency Funds
EC	European Community
EWS	Early Warning Systems
GCMs	General Circulation Models
ISDR	International Strategy for Disaster Reduction
ITIKI	Information Technology and Indigenous Knowledge with Intelligence
NDVI	Normalized Difference Vegetation Index
NIMES	National Integrated Monitoring and Evaluation System
MODIS	Moderate Resolution Imaging Spectroradiometer
NDMA	National Drought Management Authority
VCI	Vegetation Condition Index

CHAPTER ONE

INTRODUCTION

1.1 Background of the Study

Drought Early Warning System enables the availability of apt, reliable, and helpful information, via selected institutions, that enables the people who are prone to any dangers to seize action to shun or ease their peril and get ready for valuable reaction (Marrs, 2014). Marrs alludes that it's a practical instrument used to implement opportune and appropriate reply to droughts and famine by providing food aid and other alleviation strategies. It entails forecasts that are based on climate protrusions and the area's drought records, likely results of developing drought incidents, and giving answers to questions regarding how long a drought may last and how brutal it can be.

There is a noteworthy scientific advance in the previous year's regarding weather forecast from around six months prior to facilitate judgment makers lessen threats that relate to climate changes (Schubert et al., 2014). General Circulation Models (GCMs) and associated statistical ensemble methods are in use to give predictions of the impending weather irregularities and give guarantee for helpful forecasts of the start, harshness and period of drought for huge geographic areas each month and season (Dai, 2010). An effective early warning system involves both technology and stakeholders in drought planning and management. Getting a clear understanding of the vulnerability to drought facilitates in increasing areas awareness and then restricts the utmost and most upsetting consequences of the peril.

Drought early warning system (DEWS) is the most important components used for drought mitigation strategies for containing and managing the consequences of drought throughout the world. One of its major goals is to avail data that enables people to deal with food insecurity states by encouraging better food conservation, saving funds for food purchases when there is a food insufficiency and growing early growing plants. The system entails gathering, analyses and distribution of data that relates to vulnerability and challenges of drought (Akwango et al 2017).

Akwango et al (2017) further argues that the operation of DEWS to add to apt reaction to drought and food safety is guided by opportune creation and propagation of information, and the capacity of the domestic to suitably put into practice the coping mechanisms. It also has the latent to make stronger the capacity of the people in handling and reducing drought consequences by building vigilance and providing coping methods.

Kenya's journey on drought mitigation and management started in 1981, through Turkana Rehabilitation Project funded by European Commission, Kenyan Government and Government of the Netherlands. The aftermath of the 1984 devastating drought led to the formulation of a drought contingency planning unit in Turkana area in 1987, funded by the Kenyan Government, European Union, Government of the Netherlands and OXFAM. In 1992 the Drought Monitoring Project by the Netherlands Government was implemented covering Turkana, Marsabit, Moyale, Isiolo and Samburu Districts. Consequently, from 1993-95 the World bank in collaboration with the GoK funded the Emergency Drought Recovery Programme. From 1995-96 the Drought Preparedness, Intervention and Recovery Programme was launched to address the adverse effects of drought in ASALs. In 1996-2003, the Arid Lands Resource Management Project I was launched covering 11 ASAL Districts. Arid Lands Resource Management Project II was launched in 2003 covering 28 Arid and Semi-Arid Areas (ASALs) of the country. With the establishment of National Drought management in 2011, a new Drought Early Warning System was designed covering 23 ASAL Counties (NDMA, 2017).

Even though Kenya has had major suffering from the periodic droughts all through its history, their extent and severity is on the increase of late because of global climate alterations. This is predominantly true of the arid and semi-arid lands (ASALs) that cover over 80 per cent of Kenya's land area. The social-economic results of drought have significant effects on the whole country. Brutal droughts and floods usually cause an annualized decrease in GDP of 2.4 per cent. Timely and suitable reaction to drought can save lives and enhance Kenya's general economic and social enlargement, besides bettering the livelihoods in the poor areas of the country (REGLAP, 2012).

Drought monitoring is essential if you want to have efficient drought management. Mostly in the drought-prone nations, it is vital to endlessly watch droughts and the affected people to prevent adverse results. To facilitate a quick reaction, short instant lags are needed between the facts attainment and information discharge (A. Klisch & C. Atzberger, 2016).

To effectively mitigate drought and management, the Government started the National Drought Management Authority (NDMA) through Legal Notice Number 171 of 2011. The body is mandated to coordinate all issues regarding drought management such as implementation of regulation concerning drought management. In order to be in line with National Integrated Monitoring and Evaluation System (NIMES), the Authority developed a Drought Early Warning System (DEWS) with a view of monitoring, evaluation and reporting severity of drought. The Drought Early Warning System (DEWS) covers 23 Arid and Semi-Arid Lands (ASAL) Counties in Kenya as at December, 2016. The System works by assessing the sternness of drought and its blow via the use of amalgamation of remote-sensed data of Vegetation Condition Index (VCI) and social economic information to agree on the drought condition. VCI passes the information regarding the state of vegetation cover, gives a comparison with the series of values got in the same duration in the earlier years (NDMA, 2017).

In 2014, the NDMA got Drought Contingency Funds (DCFs) coming from the European Union (EU) to make possible early reaction to drought fears. The DCFs are distributed by NDMA to drought-prone counties to finance reaction actions that can help contain the nastiest effects of droughts (Klisch & Atzberger, 2016). To find out the (agricultural) drought position of a (sub-) county in an idea, reproducible and cost efficient manner, NDMA made the decision to utilize Earth Observation (EO) facts. For close to real-time (NRT) stipulation of EO information, the University of Natural Resources and Life Sciences designed and put in place a sophisticated filtering system for Moderate Resolution Imaging Spectrora-diometer (MODIS) normalized difference vegetation index (NDVI) images for NDMA (Klisch & Atzberger, 2016).

With the implementation of Drought Early Warning System by NDMA it is expected that the National and County Government can use the available information to initiate measures that can minimize the severity of drought. In December, 2016 the United Nations warned of a serious drought in early months of 2017. Subsequently, in January, 2017 NDMA through its National Drought Early Warning bulletin expressed fears of severe drought of which if no urgent and appropriate action is taken to mitigate the drought, the Country could see a repeat of the drought situation in 2011 (Ochola, 2017).

1.2 Problem Statement

Abdulfatah, (2012) did a study on the issues that affect the execution of drought mitigation strategies in Kenya: A case of Mandera County. The study concentrated on social factors, economic factors, level of community awareness and the mechanisms that could be put in place to minimize the effects of draughts. Muhuba (2013) in an evaluation of community based drought cycle management as an approach for adversity threat reduction: the case of community drought cycle management in Wajir County found that of the various coping strategies used, the community opted to move their animals and families to other places in search of pasture during drought.

Musimba (2014) investigated the role of community participation in drought risk management in Kilifi County, Kenya and found that there was a significant role of community participation in drought risk management as the process was implemented by the community themselves although in most of the cases the criteria was predetermined and dominated by experts who assertively considered the contribution of community.

In Uganda (Akwango et al, 2017) did a study on the consequences of drought early warning system on the domestic food safety in Karamoja sub-region, Uganda and found that due to irregular drought occurrences in the Karamoja sub-region, DEWS adds to household food safety and nourishment by availing people with data on opportune cultivation, crop variations, farm tools, drought management and drought-resistant crop varieties. DEWS practitioners should major on facts dissemination, availing drought-resistant plants and offering training chances to people for improved production in semi-arid areas.

Despite the numerous studies documented on drought mitigation, risk and management, increased frequency and intensity of drought, lack of proper drought mitigation strategies and coordination by various stakeholders have all mired efforts to mitigate drought and avoid/reduce disaster. Whilst many studies have concentrated on one county or region; this study will cover 23 ASALs in Kenya. DEWs being a crucial component of drought mitigation strategy, there is need to evaluate its eminent impact. It was because of this that the current research sought to establish the effects of Drought Early Warning System (DEWS) in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya.

1.3. Objective of the Study

1.3.1. General Objective

To conduct an assessment on the effect of Drought Early Warning System (DEWs) in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya.

1.3.2. Specific Objectives

1. To analyze the effect information quality of DEWS has on drought contingency planning in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya,
2. To assess the influence system quality of DEWS has in drought mitigation strategies in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya,
3. To ascertain the effect service quality of DEWS has on drought risk management in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) Kenya.

1.4. Significance of the Study

To Stakeholders

The policy developers within the drought management sector may rely on the recommendations to come up with relevant policies and strategies for curbing and mitigating losses caused by drought disasters in the Country. The NDMA and other relevant stakeholders can identify gaps in the DEWs and improve it in future.

The Academicians and Scholars

It is hoped that future researchers may utilize the results of the research as a basis for auxiliary research. This can reduce unnecessary duplications and improve the quality of research being carried out in the country. It can also provide ready data for reference to various stakeholders and scholars. The study will also add value in academic research more specifically relating to EWS, DEWs, drought mitigation and management.

1.5. Assumptions of the study

The study made assumption that all members of the County Food Security Steering Group (CFSSG) in the 23 ASALs sampled would be available for interview and the respondents would give accurate information. The study also made assumption that sufficient duly filled questionnaires would be returned for data analysis. The facts collected were based on sample and the basic assumption was that this data would be representative.

1.6. Limitations of the study

According to (Njoka, 2016) Kenya has 23 ASAL counties that make up around 88% of the country’s land area. From the 23 of them, 9 are arid and the remaining 14 remain to be semi-arid lands. The degree of dryness in the ASAL counties and athwart counties is uneven. These arid counties are largely pastoral, with partial yield cultivation. The semi-arid counties are typically agro-pastoral, and practice crop or livestock farming systems. There was a big challenge of availability of resources to collect data from all the 23 ASAL counties. Despite designing online questionnaires, some counties did not have stable internet connection to enable them to fill on time. Lastly, unlike most studies, this area of DEWs especially in East and Central Africa did not have abundance of literature and previous studies to refer to.

CHAPTER TWO

2.0 LITERATURE REVIEW

2.1 Introduction

The literature analysis is a critical evaluation of existing published research in the vicinity of drought mitigation and management. Analysis and review on Drought Early Warning Systems, drought contingency planning, drought mitigation strategies, drought disaster risk management and evaluation of IS will serve as the background of this study. The other sections cover theoretical framework and conceptual framework.

2.2 Empirical Review

Hayes, et al., 2009 defines drought as a shortage of rainfall comparative to what is probable i.e., usual that, when prolonged over a period, causes inability to cater for the load of human actions and the surroundings. In this definition drought is described as a shortfall of rainfall over a prolonged duration, a season or even extended durations, but it may also relate to the uneven distribution of rain over a rainy period, for instance when a dry spell results into damage of a crop during a rainy season that otherwise has average total rainfall or even above.

In relation to sub-Saharan Africa, there is increasing concern on the probable consequences of climate alteration on agriculture, economic enlargement and conducive growth. This is as a result of the region experiencing more droughts in of late because of the amplified temperature and constrained rainfall. Prevalence of climate alteration comprise of alterations in the moisture, soil feature, crop pliability, length of plant seasons, output of the yields, atmospheric temperatures, weed uprising, flooding, extraordinary droughts, rise in the sea levels and many others (Ozor and Nnaji, 2011). This unfavorably affects agricultural operations that are the foundation of most African markets. The state is worsened because of things like the extreme poverty, over reliance on rain grown crops, unjust land allocation, partial access to funds and technology, insufficient public infrastructure like roads, weather forecasts and scarce study and extension (Intergovernmental Panel on Climate Change (IPCC, 1998).

Consequences of drought may be ex post and ex ante. Ex post consequences are the fatalities that pursue a weather shock and ex ante are the chance expenses linked with unadventurous methods that risk-averse decision makers use in advance to guard themselves from the climate shocks (Hansen et al. 2004). The chief conformist ex-ante responses of farmers to climate threats documented by Hansen et al. (2004) include the utilization of not risky but less profitable crops or cultivars, avoidance of the risky enhanced production technologies, under-use of fertilizers, and shifting household labor from farming to non-productive but more liquid assets as deterrent savings. Due to high relative risk repugnance, inferior households are usually impacted by ex-ante responses to climate variability than the rich ones even when the years are good (Zimmerman and Carter, 2003).

Pastoral people in arid and semi-arid regions (ASAR) of Africa always have the anticipation of drought. They go on to endure, and arguably suffer catastrophic fatalities of livestock when it is a dry season. The impact of drought is predominantly sharp for inferior people with smaller livestock and less advanced social support connections (J. Swift, D. Barton, J. Morton, 2001).

The core cause of the country's susceptibility to drought is in its reliance on precipitation for its development. Agriculture is the basis of the economy and in most cases it is entirely fed by rain. Water for human use is got from rivers that are recharged by rainfall. Kenya experience water scarcity with per capita water accessibility being very low compared to other countries in Africa, which makes clean water access a major trouble in the country, including the areas in the capital, which is Nairobi. The drought in the year 2000 came with major risks such as drastic power rationing. In this period, the Kenya Power Company incurred a loss of US $20 million, the economy was greatly paralyzed and the national GDP constricted by 0.3% (Kandji, 2006).

The financial and environmental consequences of drought are expressed in diverse manner (Hansen et al., 2004, Hellmuth et al., 2007 and Bhavnani et al., 2008). These may be such as crop productivity, rangelands and forests; amplified fire threats; condensed water ranks; enlarged livestock and wildlife deaths toll; and harm to flora and fauna living areas. These things may finally be visible in ways such as condensed outputs for farmers and agribusiness; amplified food costs; joblessness; abridged tax returns; more divergence, outmigration and dislodgment;

starvation and food crisis; illness calamities and more bug infestations; and swell of plant infections and more erosion.

2.3 Drought Early Warning Systems

Early warning systems are a set of abilities useful for generating and distributing suitable and important warning data to enable households endangered by drought to get ready and act properly and timely to lessen the likelihood of harm or failure. Toughness to drought made better by the formation of early warning systems that include an organization for enhanced coordination of drought alleviation actions among stakeholders (Wilhite, et al, 2005).

Countries all over the globe are trying to establish national drought methods and one major element to include is the establishment of an all inclusive drought monitoring system with the capability to give timely warning of the drought's beginning, find out drought harshness and spatial degree, and pass on that data to the decision-makers quickly. This data can be utilized to diminish or shun the drought impacts (AMS, 2011). A useful drought early warning system supports suitable alleviation and awareness mechanisms that ease the effects (Masinde, 2015).

Early warning (EW) is the availing of opportune and useful data, via selected parties, that permits those prone to hazard to engage an action that will help avoid or lessen their peril and get ready for helpful reaction, and is the incorporation of four key fundamentals as per the United Nations' International Strategy for Disaster Reduction (ISDR), As per the (UN 2006) it incorporates: 1. Risk Knowledge: Risk assessment gives useful data to set precedence for alleviation and avoidance mechanisms and designing timely warning systems. 2. Monitoring and Predicting: Systems with monitoring and predicting abilities give timely approximation of the likely risk that the communities face, economies and the surroundings. 3. Disseminating Information: Communication systems are useful for giving warning alerts to the likely affected areas to sensitize local and regional governmental bodies. The alerts must be dependable, synthetic and straightforward for the public to understand. 4. Response: Coordination, proper power and suitable act plans are major in successful early warning. Similarly, public consciousness and education are key elements of disaster alleviation.

Improvements in technology has enabled monitoring nearly all pollutants and ecological deprivation phenomena in real-time to notice unpleasant trends and implement steadfast predictions of likely consequences in the manner of early warning systems (EWSs). An EWS is an integrated system used to monitor, gather data, analyze, interpret, and broadcast the data, which can be utilized in decision making that are timely to guard the public health and the ecology and to reduce needless anxiety and difficulty to the people (USEPA, 2005). Multiple programs are used in ecological monitoring but not many are wholly integrated EWSs that can sense pollution and degradation activities in time to permit for a helpful reaction able to minimize the impact of a disastrous ecological phenomenon (Quansah et al, 2010).

There are advanced technologies, like the remote sensing and contaminant samplers, that are in use in gathering data in almost all the ecological monitoring systems, but it is necessary to incorporate EWSs encompasses multidisciplinary information. Socio-economic indicators like the population expansion, market trends, food accessibility and costs, health status, occurrence of undernourishment, and the sustainability of the agriculture industry are critical elements of multidisciplinary information for EWSs. High-tech facts gathering processes, statistical, and integral analyses are critical in giving regular applications of the EWSs (Quansah et al., 2010).

The unstable state of the global ecology has necessitated advancements by the UN, governments, NGOs, and academics to finance study and put in place decisions and projects that are designed to watch and help prevent the occurrence toward any more environmental deprivation. To attain this objective, EWSs are introduced to monitor the ecology and forecast likely harsh effects in time to permit for events to be adopted to minimize the unkind impacts. Ecological deprivation, contamination, and natural calamities are global challenges, it is necessary to understand how some EWSs have achieved their objectives, so as to persuade the reproduction of these systems in like hot spots (Quansah, 2007).

Akwango et al 2017 states that Drought early warning system (DEWS) is one of the accessible ways of dipping and managing the consequences of drought throughout the globe. One of the major goals of the DEWS is to give data that helps people to deal with with food uncertainty states by encouraging food holding, saving resources to buy food when there is food shortage and growing early maturing plants. The system entails gathering, analyses and distribution of data regarding the drought risks. The structure also makes the households ready to deal with the drought effects.

To moderate drought peril in Kenya, in 2011, a National Drought Management Authority (NDMA) was started to vigorously handle droughts. NDMA's consent is to work out universal management and harmonization over all issues about drought management in its region. In 2014, the NDMA got Drought Contingency Funds (DCFs) from European Union (EU) to ease speedy reaction to drought fears. The DCFs are distributed by NDMA to drought-prone counties to pay for the reaction actions that can aid in reducing the most horrible consequences of droughts (Klisch and Atzberger, 2016).

As per Klisch and Atzberger (2016) to find out the (agricultural) drought standing of a sub-county in a clear, reproducible and price competent manner, NDMA decided to utilize Earth Observation (EO) information. For near real-time (NRT) availing of EO information, the University of Natural Resources and Life Sciences (BOKU) designed and put in place a superior filtering mechanism for Moderate Resolution Imaging Spectroradiometer (MODIS) normalized difference vegetation index (NDVI) images for NDMA. The BOKU processing gives dependable drought indicators at county and sub-county areas for diverse aggregation period and living zones. The image analysis is supported by field-based (socio-economic) measures at NDMA as well as satellite-based precipitation approximations from the TAMSAT grouping of University of Reading (UK). The innovative DCF payout methods of NDMA make sure an opportune hold up of drought-affected counties and people. As DCFs are only distributed to county governments having accepted drought alleviation methods, the situation also gives an inspiration for drought attentiveness actions.

Masinde (2015) wrote an article on a novel drought early warning system for sub-Saharan Africa: incorporating current and native methods. The editorial entails an inventive drought early warning system that encompasses original and scientific famine forecasting methods. The system is based on a fresh amalgamation framework called ITIKI (Information Technology and Indigenous Knowledge with Intelligence). Indigenous awareness makes sure the system is applicable, satisfactory and flexible. ITIKI additionally uses three ICTs to improve the system's efficiency, sustainability and aptitude. In my view, this modern technology is more efficient and can be replicated in Kenya by NDMA.

2.4 Drought Contingency Planning

Drought contingency planning is a methodical procedure to integrate drought risk management from well developed, coordinated and supported drought contingency tactics. The prominence in drought contingency planning is to make official and enforce the progression from clearness in the duties of various people, communities and organizations in handling the drought risks (Ibrahim, 2016).

Levine, Crosskey, and Abdinoor, 2011 alludes that, though drought contingency plans got a variety of actions to hold up drought risk lessening by having smallest preparedness, reaction and recovery activities, there is a limited link among awareness, early warning and early act/ reaction. Contingency planning has not help the public to be on timely since it never informed the people regarding the necessary actions. Ibrahim, 2016 further argues that nearly all drought contingency plans are reaction driven with minimal stress on mitigation. This can be linked with technical capability of those concerned with contingency planning and the time for its development is very short and does not make part of the main drought risk lessening method. Drought contingency plans are inadequate to manage interagency drought contingency planning for successful preparedness and reaction.

According to Wilhite et al, (2000) Drought plans must have three essential elements: monitoring and early warning, risk appraisal, and alleviation and reaction. A ten-step drought preparation procedure shows how the elements of a plan are handled when developing the plan. Because of drought's sluggish start traits, monitoring and early warning systems give the basis for a useful drought mitigation plan. A plan should rely on correct and opportune assessments to cause mitigation and emergency reaction programs.

A key element of drought planning is the availing of appropriate and dependable climate data that include seasonal estimates, that helps policy makers at all stages in giving serious management choices. This data, if well used, can lessen the consequences of drought and other severe weather proceedings (Wilhite, Sivakumar and Wood, 2000).

The eventual goal of the drought reaction system is to encourage early alleviation efforts that cut the time taken from when a warning of drought anxiety is given to when the county response happens. Drought alleviation mechanisms will take a livelihood outlook and be particularly made to offer support to the local economies and encourage linkages with long-term advancement mechanisms. This is done to lessen the losses of property by households throughout drought crises and add up to improve resilience (Wajir drought contingency plan, 2014).

According to Mainlay & Tan (2012) past actions have mainly had their focus on involvements after drought with modest investments in escalation of the communities capabilities to handle threats. Existing drought contingency plans, mostly in the northern Kenya and southern Ethiopia are ad hoc with slight local point inputs and mainly top down based on Government's departmental level staffs" insight of the community wants. There is want to overturn this move and have the focal point on contingency plans that begin from the local people and integrate into district and national stage drought disaster plans

2.5 Drought Mitigation Strategies

The harsh drought occurrences that have happened world-wide in the precedent decades have amplified alertness to the significance of the consequence of this hydro-meteorological risk and have induced multiple researchers and decision-makers to come up with drought mitigation ways. The need of an imperative reaction to drought challenges is powerfully known in arid and semiarid areas, in which the peril of harsh water inadequacies is on the rise because of the rising demands on inadequate water that presents an elevated natural variability (Rossi, 2000).

Drought can be predicted and managed, and if not so, there are main socio-economic challenges mostly in the developing nations where an upshot of drought is the peril of tremendous food uncertainty (UNISDR, 2007). The unpleasant impacts of risks frequently cannot be contained wholly, but their level or harshness can be considerably made easier by a variety of mechanisms and activities. Regardless of numerous mechanisms to battle the consequences of drought on food making, deficits always occur (Omiti and Nyanaba,2007).

2.6 Drought Disaster Risk Management

The sternness of drought peril is understood by the contact amid levels of contact and stages of susceptibility to famine (GoK, 2014). In Kenya's the arid and semi-arid lands (ASALs) there is major exposure and vulnerability. Drought helplessness is an invention of the constant under-development of these areas, mostly the incomplete stipulation of communal supplies like safety, setups and services that make people wealthy. In counties like Turkana, constant surveys and appraisals states that the leading problems to elasticity is disagreement that involves movements and trade, prevents outlay and services, and ensures that major grazing is not accessible (NDMA, 2014).

Goyet, (2009) challenges the fairy tale that drought affected people would be too surprised and powerless to take liability for their survival as outdated by the actuality that several find new might during these emergencies. Communities affected by drought disasters have a responsibility to act in disaster peril management and should be given the maximum opportunity to participate in risk reduction and response programmes. People are involved to solve their challenges and cannot be compelled to take part in the projects that affect their way of life but must be allowed the chance for involvement as it is a basic human right and a primary democratic principle (Mainlay & Tan, 2012).

2.7 Strategies for IS Evaluation

There are 3 mechanisms used to assess Information Systems. These are; Goal based evaluation, goal-free evaluation and the criteria based evaluation.

2.7.1 Goal-based evaluation

Goal-based evaluation is the formal-rational to its traits (Walsham, 1993). Walsham states that a formal-rational vision views evaluation mostly as quantitative procedure of estimating the probable expenses and payback. As per Patton (1990) goal-based evaluation measuring the degree to which a plan or involvement has got apparent and exact goals. The heart is on the planned services and results of an agenda i.e. the objectives. Good et al (1986) asserts that evaluations must be quantifiable and that the evaluation needs to convene the needs requirement.

2.7.2 Goal-free evaluation

As per (Remenyi, 1999; Walsham, 1993) Goal-free evaluation method is interpretative. The interpretative viewpoint views IT-systems as social systems having information technology entrenched into it (Goldkuhl & Lyytinen, 1982). The major of interpretive evaluation is to get a closer thought of the character of what is being evaluated and to develop inspiration and obligation (Hirschheim & Smithson, 1988). The participation of a wide variety of stakeholder is regularly considered important to this method of evaluation. This can be a handy impediment where time or wealth for the assessment is short. Patton (1990) utilizes the term goal-free evaluation, which is known as collecting data on a wide array of real effects and evaluating the significance of these effects in fulfilling the demonstrated requirements (Patton, 1990, Scriven, 1972). The evaluator tries a purposeful shot to shun all rhetoric related to agenda objectives; no conversation about objectives is apprehended with the personnel; no plan brochures or proposals are read; only the program’s results and quantifiable effects are done.

2.7.3 Criteria-based evaluation

There is lot of criteria-based methods such as checklists, heuristics, or quality ideals. In the area of human-computer interaction you may get various checklists or heuristics (Nielsen, 1993, Nielsen, 1994; Shneiderman, 1998). What is distinctive for these methods is that the IT systems interface and the contact among users and IT-systems is a foundation for the evaluation jointly with a set of already defined criterion. More exploit oriented quality principles for evaluation can be got in Cronholm & Goldkuhl (2002) and in Ågerfalk et al (2002). The basis for theaction-based ideals is to get if and how the IT-system hold up the actions done in the business.

According to Cronholm and Goldkhul (2013), these different evaluation approaches can be utilized together in combined ways practically when evaluating systems. They can be utilized in varying stages, where evaluation outcomes from the previous stages notify the others. It might be likely to merge some of these in an integrative manner with direct alterations in mind. Goal-based, goal-free and criteria-based are the three basic attitudes that can be applied in evaluative manner. A wavering among these attitudes may be probable to do during a joint evaluation procedure.

2.8 Theoretical Frameworks

According Eisenhart (1991) a theoretical framework is defined as "a formation that guides study by depending on a formal theory that is developed using a reputable, rational clarification of a given phenomenon and relations" Thus, the theoretical framework is made up of the chosen theory that undergird your thoughts in relation to how you comprehend and plan to study your subject, as well as the notions and definitions got from the theory that relate to the topic. Lovitts (2005) empirically states it as the criterion for applying or designing a theory to the thesis that must be suitable, logically interpreted, well known, and in line with the inquiry at hand.

Seddon (2001) alludes that there is a large amount of money utilized on IT All over the world. It is consequently necessary to evaluate the output. Evaluation is not at all an easy thing and so there are a lot of suggestions on how to assess IT-system. Much of the works on evaluation adopts a formal-rational sight and views evaluation as a principally quantitative procedure of calculating the probable cost and advantage on the foundation of defined manner (Walsham, 1993).

There are various models and frameworks that have been utilized to assess Information Systems. For the purpose of this study, I will review Belief Action Outcome Model, Proposed Integrated Success Model, DeLone & McLean IS Success 1992 Model and DeLone & McLean 2003 IS Success Model.

2.8.1 Belief Action Outcome Model

Challenges facing information systems and environmental sustainability are human traits and the wider social, organizational, and ecological framework (Melville et al, 2010). Melville further argues that human living is dependent on the natural surroundings, which is speedily demeaning. Businesses are a leading form of social association and add to the deterioration and development of the natural surroundings. Administrative science researchers scrutinize issues regarding the organization and the natural surroundings but in most cases they never remember information systems point of view.

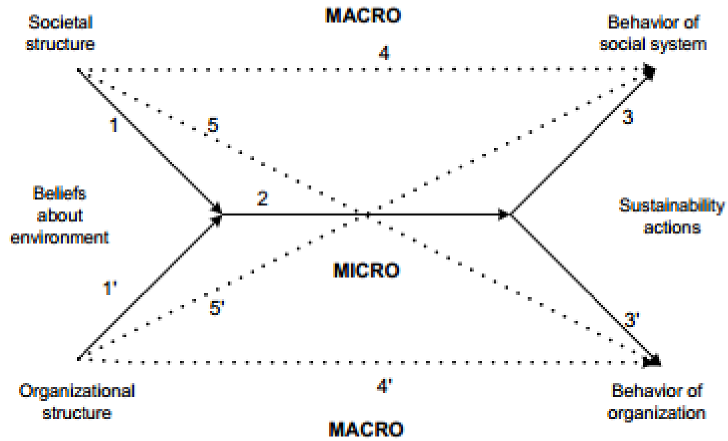


Figure 2.1; Belief Action Outcome Model

Coleman's (1986, 1994) model of micro–macro relations gives the basis for BAO framework. The model underscores the mediating function of peoples in linking macro-level variables like the social arrangement and the traits of the social system. There are three types of relations that include: (1) macro-level variables like the social structure has effects on the psychic states, these are beliefs, desires and chances of people; (2) psychic states has effects on the peoples activities; and (3) combined personal activities that affect macro-level variables like the traits of the social system.

The BAO framework uses an extra element; organizational structure and an additional outcome, traits of a firm are brought in. In this way, the researchers give account for double socialization (individual psychic states are shaped by social structure (link 1) and organizational structure (link 1')) and dual outcomes (combined individual action may improve organizational (link 3') and environmental (link 3) performance). In accordance to the belief formation, tensions may come up within peoples because to frictions between firm and personal beliefs that are determined by the society. In relation to outcomes, definition of financial and environmental act underscores the significance of the dimensions of the performance; an environmental handling program that minimizes outlay but does not visibly better the environment is of uncertain environmental worth. The concluding extension is to embrace dashed lines that link four macro–macro states, giving room for research methods that presume away the variations in individual human traits and assume firms as collections of similar structures (links 4, 4', 5, 5'). Improved understanding of the fundamental mechanisms of personal links (e.g., link 1) as well as numerous links is an affluent basis of more research on IS for the environmental sustainability.

In summary, the BAO framework gives a method to frame the research questions interconnecting information systems and environmental sustainability in the organizations, is well-matched with IS research assortment, and includes macro and micro viewpoints that are contained in the academic and popular writings (Erdmann et al., 2004, Farrell & Oppenheim 2008 and Romm, 2002).

2.8.2 Proposed Integrated Success Model (ISM)

A. Nasser H. Zaied, (2012) utilized the Technology Acceptance Model and DeLeon & McLean updated IS model to come up with the integrated evaluation model of IS success. This representation was utilized to appraise the vital success things that had effects on the information systems in the communal segment in Egypt. The model is of use in helping decision makers evaluate and advance the information systems.

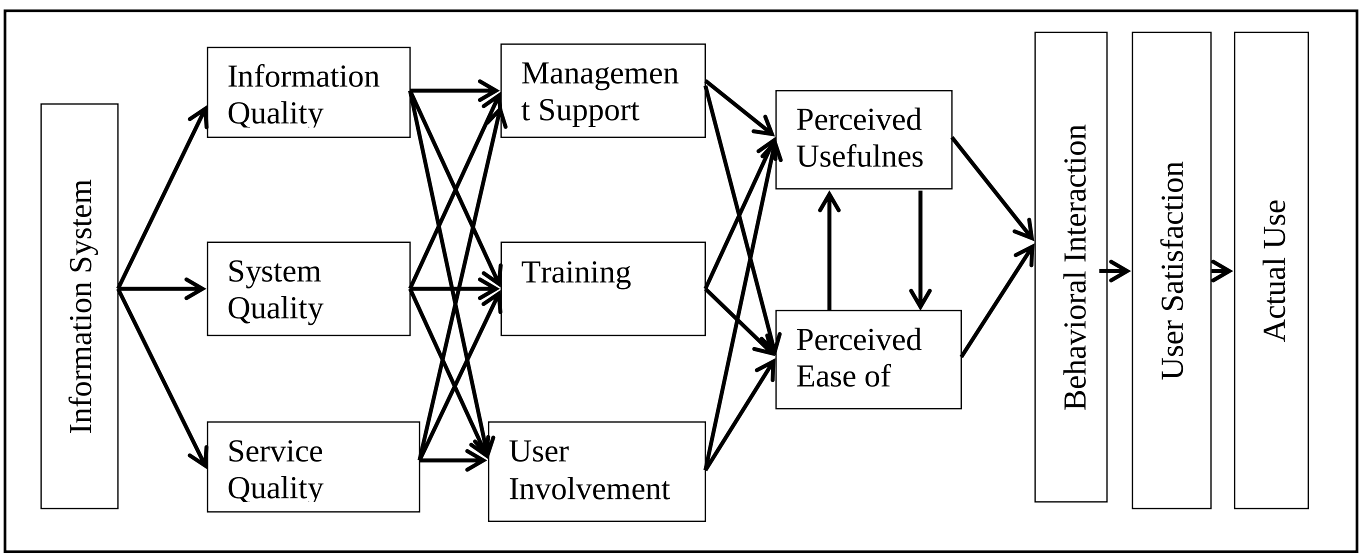


Figure 2.2 Integrated Success Model (ISM)

To measure the IS success, there were ten elements that were projected (B.P Kaur and H. Aggrawal, 2013).They include Service quality; Perceived usefulness; System quality;

Management support; Information quality; Perceived ease of use; User satisfaction; Training; User involvement and Behavior purpose.

The model presumes that information, system and service quality are interlinked to the management support, training and the user involvement, and they have influence on the apparent usefulness and the ease of use that has some effects on the trait intention and the user satisfaction.

2.8.3 DeLone and McLean IS Success Model (1992)

DeLone and McLean (1992) developed an information systems' success model grounded on the synthesis of previous research involving IS success. The more integrated and comprehensive IS model shows that success depends on several factors that are interrelated to each other. Six constructs are typical of this model and consist of: system quality, information quality, usage, user fulfillment, personal impact and organizational consequences.

Most of IS are represented by system and information quality. The impact of a system can be felt if it's utilized by the people who can either be contented by it or not as well as during its usage. The impact would then bring about the organizational impact. System quality in this model therefore quantifies technical achievement, while information quality calculates semantic accomplishment. The other four constructs, use, user satisfaction, individual impacts and organizational impacts measure success related to effectiveness (DeLone and McLean, 1992).

Further, the process model suggested that both information quality and system quality can have an impact on use and user satisfaction. Additionally, use and user satisfaction can influence each other either positively or negatively and both can therefore lead to an individual impact that would then lead to an organizational impact. DeLone and McLean further added that items for all the six constructs need to be carefully chosen to ascertain the overall IS success.

Figure 2.9 below shows the IS Success Model developed in 1992:

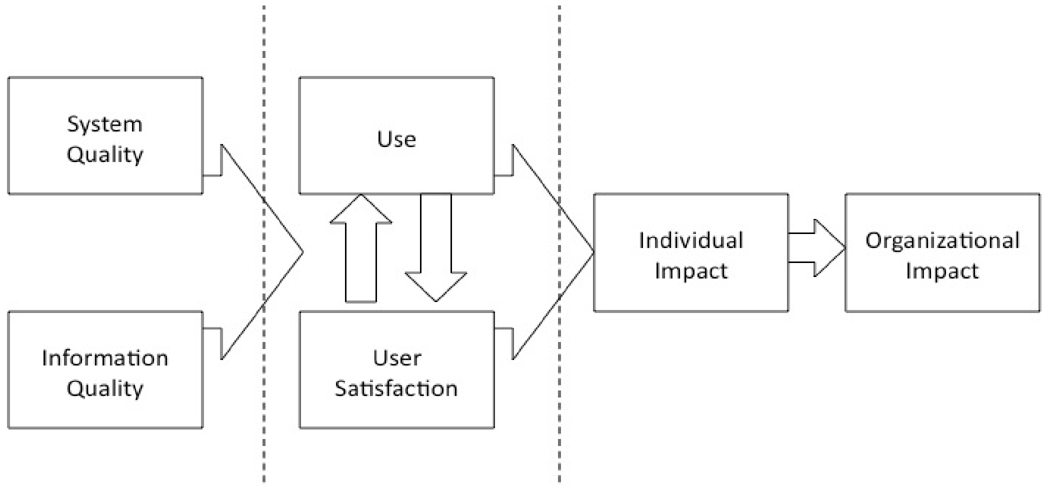


Figure 2.3: DeLone and McLean IS Success Model (1992)

2.8.4 DeLone and McLean IS Success Model (2003)

After DeLone and McLean developed an information systems' success model in 1992, they welcomed criticism and suggestions for modifications to the model. Following this, they performed empirical tests and revised the model (DeLone and McLean, 2003). Following the recommendation of Pitt et al. (1995), the construct of service quality was added in the updated version. The net benefits variable replaced the individual and organizational impact constructs thus enabling multiple levels of analysis of benefits. One other modification made to the model involved the use construct, where DeLone and McLean (2003) explained that this variable must occur before user satisfaction in procedure logic whereby positive experience with use would result in a higher level of user satisfaction in a causal sense. This would therefore translate to an increased user satisfaction resulting in higher intention to use together with an effect on use. Figure 2.2 below shows the modified version of the IS success model (Delone and McLean, 2003)

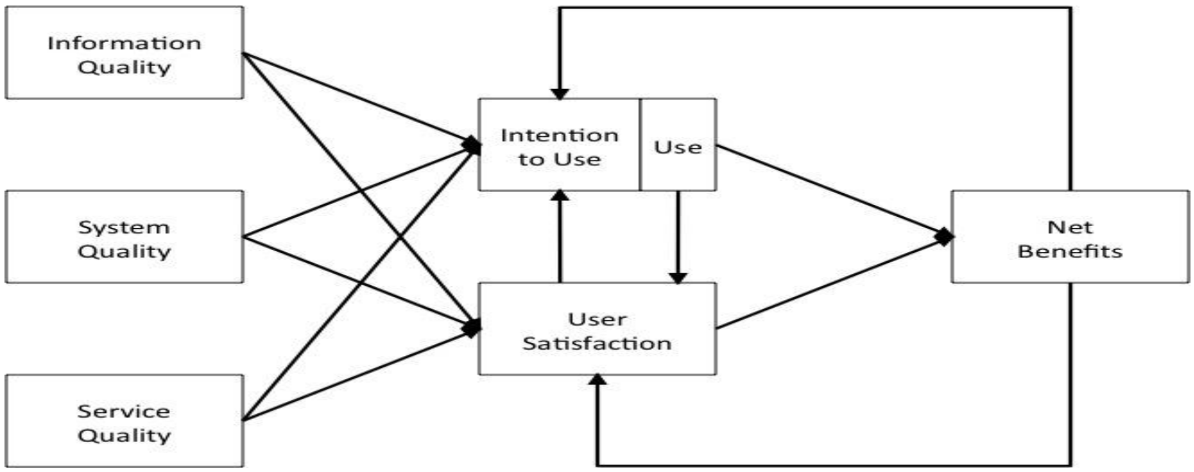


Figure 2.4: Updated DeLone and McLean IS Success model (2003)

The six constructs can be defined as below:

1. **Information Quality** – This construct assesses the desirable characteristics of the system outputs, i.e. management reports and web pages; for example; relevance, understandability, accuracy, conciseness, completeness, timeliness and usability.

2. System Quality – This construct assesses the desirable characteristics of an information system. This includes; system flexibility, ease of use, system reliability, ease of learning, as well as system features of intuitiveness, flexibility, sophistication and response times.

3. Service Quality – Refers to the inclusive support that can be supplied by a service provider notwithstanding whether the backing is provided by an internal IS department, a novel unit in an organization or outsourced to an ISP (internet service provider). Service quality as construct of IS success is measured using indicators like responsiveness, reliability, technical competence, assurance and empathy in the support offered by the service provider to the end-user. SERVQUAL, adapted from the field of marketing, is a popular instrument for measuring IS service quality (Pitt et al., 1995).

4. System Use – This construct assesses the level and mode in which employees and users use the abilities of the information system. These include; total usage, regularity of utilization, nature of utilization, utilization appropriateness, degree of use and reason for usage.

5. User Satisfaction – This construct assesses the overall rank of customer satisfaction and can be a significant method to measure user opinions. User satisfaction has got substantial notice from scholars since 1980s as a vital proxy gauge of information systems accomplishment (Ives et al. 1983; Bailey and Pearson 1983; Baroudi et al. 1986; Benson 1983). Several models used to measure user satisfaction were established, including the user information satisfaction instrument done by Ives et al. (1983) and the 12-item EUCS tool done by Doll and Torkzadeh (1988).

6. Net Benefits – Evaluates the degree to which IS are causative to success of employees, organizations, markets, customers, industries, markets, suppliers, societies and economies. Net benefits can be; enhanced decision-making, better productivity, improved sales, better profits, job creation and economic advancements. Brynjolfsson et al. (2002) utilized production economics to gauge the bang of IT investments on the firm-level productivity.

2.9 Conceptual Framework

Mugenda & Mugenda (2003) describes a conceptual framework as a hypothetical model that identifies the study model by mapping relations among them. According to Creswell (2005), the aim of a conceptual framework is to mainly classify and outline relevant concepts that would map the research terrain or conceptual scope, identify gaps in literature and systematize relations among concepts. Kothari (2004) further defines conceptual framework as an instrument the researcher's utilizes to direct their investigation and also a set of thoughts utilized to organize the study, a roadmap. It is the researcher's personal view of the dilemma and defines the direction the research will take. It may be an adjustment of a model utilized in a previous research, to fit the inquiry. Notwithstanding from giving the track of the research, via the conceptual framework, the scholar can give the relations of the various constructs they want investigated.

For the purpose of this research I will apply and test three constructs of the revised DeLone and McLean (2003) model of information systems' success to assess the effect DEW system has in regard to drought mitigation and management in Kenya. Hu (2002) argued that consolidated previous research findings suggested that IS success may vary noticeably based on vital organization or system characteristics and thus modification of the model should be made in accordance with the target context. The three variables namely; Information, System and Service quality will act as the independent variables to review the effects of Drought Early Warning System in drought mitigation and management.

1. Information Quality: Under this construct issue of accessibility, relevance, timeliness and accuracy will be used for evaluation.

2. System Quality: Under this construct issue of user friendliness, ease of use, system reliability and stability will be used for evaluation.

3. Service Quality: Under this construct issue of availability, responsiveness and assurance will be used for evaluation.

4. Drought contingency planning: Contingency planning links with various levels of drought risk management and are assumed to be part of the development course to ensure long term sustainable funding. The contingency planning process, guidelines and evaluation affect effectual drought mitigation and reaction at the community levels. Stakeholder coordination, timeliness of the plans, decision making tools and drought cycle management play a critical role in ensuring that the disaster risk is reduced significantly. Coordinated national drought resilience policies include inclusive monitoring, early warning, impact appraisal procedures, risk mitigation ways, drought readiness plans, and emergency reaction programs.

5. Drought Mitigation Strategies: These are the measures taken by the National Government, County Government, NDMA, communities in ASALs and other stakeholders to minimize the adverse effects of drought. The strategies applied include the provision of early warning information on drought generated through the drought early warning system. Conduct capacity building at both the National and County level more specific to communities living in ASALs. Employ Community Managed Disaster Risk Reduction (CMDRR) strategy as a drought mitigation measure.

6. Drought Risk Management: Drought disaster risk management is the policies and actions taken to prevent extreme consequences of drought. Risk Identification is a crucial component that enables drought contingency planning be undertaken. Response is the action taken by the relevant body to curb the adverse effects of drought. When mitigation strategies fail, having a recovery plan is critical to enable those affected by drought recover and get back to their normal livelihoods.

Drought Early Warning System: For the DEWs to be more effective, it should provide timely and effective information. This information is disseminated by NDMA to relevant Government agencies and communities living in ASALs. This information will be used to take action to avoid or reduce risk of drought and prepare for effective response.

As shown in figure 2.3, the independent variables include information quality, system quality and service quality while the dependent variable is drought mitigation and management.

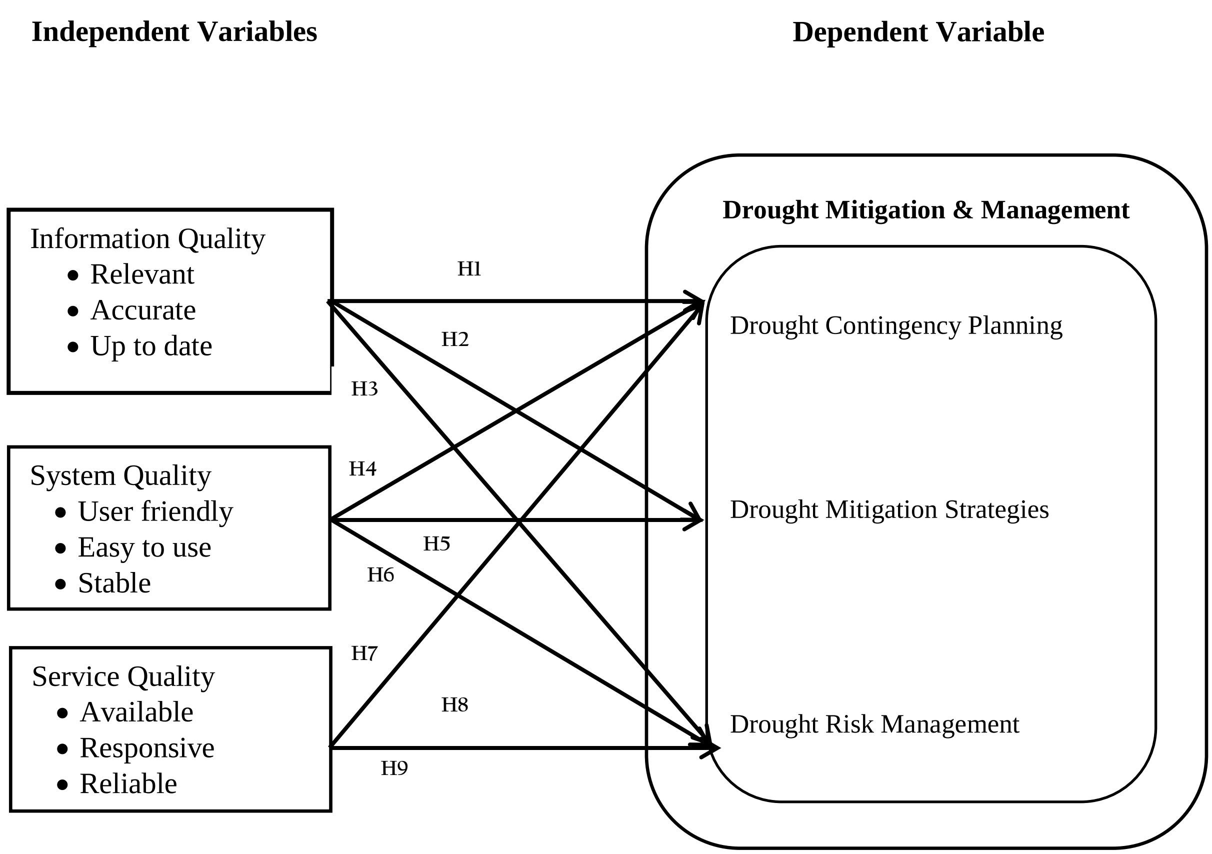


Figure 2.5: Conceptual Framework

Source: Author, 2018

The hypothesized relationships between variables, in the context of the Drought Early Warning System, shall be as follows:

H1: The provision of relevant information through the DEWs will positively affect decision making while preparing drought contingency plans,

H2: The provision of accurate information through the DEWs will enable provision of early warning,

H3: The availability of up to date Information through the DEWs will enable timely identification of drought risks,

H4: DEWs being user friendly will ensure efficiency and timely planning of drought contingency plans,

H5: DEWs ease of use will ensure the system is usable and will improve capacity building for all stakeholders,

H6: DEWs stability will ensure on time response to drought risk mitigation efforts,

H7: DEWs availability will ensure timely planning of drought contingency plans,

H8: DEWs responsiveness will ensure dissemination of early warning bulletins,

H9: DEWs reliability will ensure swift response to drought risk mitigation efforts,

Table 1 Operationalization of variables

VARIABLE	**OPERATIONALIZATION**	**SOURCES**
Information Quality	• Relevant • Accurate • Up to date	DeLone & McLean,2003; DeLone & McLean,2016; Alexandre J. and Isaías ,2012
System Quality	• User friendly • Easy to use • Stable	DeLone & McLean,2003; DeLone & McLean,2016; Alexandre J. and Isaías ,2012
Service Quality	• Available • Responsive • Reliable	DeLone & McLean,2003; DeLone & McLean,2016; Pitt et al., 1995
Drought Mitigation and Management ○ Drought Contingency Planning ○ Drought Mitigation Strategies	• Decision making • Timely Planning • Stakeholder Coordination	Ibrahim,2016; Levine, Crosskey & Abdinoor, 2011; Wilhite et al, 2000
	• Early Warning • Capacity building	NDMA, 2014; Rossi G, 2000;

○ Drought Risk Management	• Awareness(CMDRR)	
	• Identification • Response • Recovery	Goyet, 2009; NDMA, 2013; Wilhite, Svoboda and Hayes, 2007;

CHAPTER THREE

RESEARCH METHODOLOGY

3.1 Introduction

This section describes the research methodology used to conduct the research. It explains the research design, the targeted population, the sample size and sampling techniques, data gathering and research instruments, analysis of data and presentation, and data validation tests.

3.2 Research Philosophy

According to Cooper & Schindler (2008), there are two main philosophies in research, these are positivism and phenomenological, which may also be viewed in two perspectives as quantitative and qualitative approaches. This study adopted positivism research philosophy that avows that acquaintance is based from purpose and put numerically with an explanatory and predictive supremacy and not on prejudiced status of personal views. Positivism philosophy involves testing and verifying empirical data to recognize the relations that exist within variables in a certain phenomenon.

3.3 Research Design

The research used a descriptive research design. It was a positivist study, which adopted a survey. This research design uses both qualitative and quantitative data (Knupfer and McLellan, 1996). The reason of descriptive study is to generate statistical data regarding traits of the research topic that is interesting to academics. Descriptive research is concerned with collecting data that talk about occurrences and then arrange, tabulates, portrays, and describes the gathering of data.

It usually uses pictorial diagrams like graphs and diagrams to help the person studying to understand and interpret the data distribution (Knupfer and McLellan, 1996). Descriptive research can either include several variables for analysis, or only one variable. A descriptive study can use methods of analyzing correlations between several variables by conducting tests such as regression, or multiple regression analysis, and Pearson's Product Moment correlation (Knupfer and McLellan, 1996).

3.4 Target Population

Population refers to an entire group of individuals or objects that a researcher has interest in and can therefore generalize the results of the study and have observable same characteristics (Mugenda & Mugenda, 2003). The target population were users of the system from the 23 ASALs Counties namely; Baringo, Garissa, Isiolo, Mandera, Marsabit, Samburu, Tana River, Turkana, Embu, Kilifi, Kwale, Laikipia, Lamu, Makueni, Meru, Narok, Nyeri, Taita Taveta, Tharaka Nithi, Kitui, Kajiado, Wajir and West Pokot. Thus the target population comprise of five users from the 23 ASAL counties. Three users are from NDMA and the other two are representatives of the County Food Security Steering Group (CFSSG) from County Government and Central Government in each ASAL county.

3.5 Sampling Frame

For purposes of this study, the sampling frame will be 5 respondents from each of the 23 ASALs Counties. Thus, the unit of analysis will be the 115 users from 23 ASALs Counties that make up the target population.

3.5.1 Sample Size

There are several factors that determine the sample size: multivariate normality of data, estimation technique, model complexity and missing data (Hair et al., 2010). For a population less than 200, a census is recommended (Bernard and Bernard 2012). According to Oates (2005), a sample size of 30 and above is acceptable.

Samples are small parts of the total number (subsets) that could be studied (Orodho & Kombo, 2002). It can also be defined as part of the population that is observed for the purposes of making scientific statements about the population. The study used purposive sampling to get the target respondents.

A sample of 115 users will be used for the purpose of the study. The sample size will hence be 115 respondents that comprise five users from the 23 ASALs totaling 115.

Table 2: Sample Size

	GoK/AGENCY	**RESPONDENTS**
1.	NDMA (County Drought Coordinator)	1
2.	NDMA (County Drought Information Officer)	1
3.	NDMA (County Data Analyst)	1
4.	County Government Representative	1
5.	Central Government Representative	1
	TOTAL SAMPLE	**115**

3.6 Data collection Instruments

According to Sekaram (2000), data collection is defined by is the process of gathering information about a phenomenon using data collection instruments. Kothari (2004) further argued that descriptive studies involve the use of structured interviews as this is viewed as a safe basis for generalization. The study used primary data, whereby the instrument was a survey based questionnaire.

Williams, (2011), alluded that researchers collect and analyze numerical data, which is customary for quantitative research, and narrative data, which is the norm for qualitative research, in order to cater for the research questions defined for a particular research study. For this reason the study used both quantitative and qualitative research methods.

3.7 Data Collection Procedure

Before data collection, a letter requesting for authority to collect data was sent to NDMA for approval. Find the letter of approval on appendix I. After approval, the questionnaires were administered online to the specific respondents and then collected within 7 days for analysis.

3.8 Pilot Test

The study carried out pre-testing of the research instrument prior to administering it, in an effort to test the reliability and validity of the research tool. The exercise enabled the study to identify possible problems, provide clarity on the instrument and language appropriateness. The pilot test also assessed the relevance of the research objectives; testing the understanding of the respondents and research tool and any potential problems. It also established how long it takes to complete the questionnaires. The main aim of pre-testing was to determine the reliability of the research tools by checking the structure, wording and sequence of questions as well as the validity of the research instrument.

3.8.1 Data Validation

According to Tavakol and Dennick, (2011), Validity is the degree to which a tool measures what it is anticipated to measure. Pre-testing was carried out to test the relevance of the questions contained in the questionnaire. This was done through the use of actual data rather than seed data. Pretesting was conducted using ten users from two Counties. The Counties were chosen for the validity test on the basis of them having personnel who use the DEWs.

3.8.2 Reliability

Reliability refers to the level of degree to which research instruments yield consistent results (Mugenda & Mugenda, 2003; Cooper & Schindler, 2008). Reliability testing was done on selected respondents. The data collected was coded into SPSS to conduct Cronbach reliability testing so as to assess the internal consistency measure. Composite reliability measure was calculated to ascertain how well each construct in the measurement model is explained by the indicators. Chin (1998) recommended the threshold to be 0.70.

3.9 Data analysis and Presentation

Data analysis was carried out using both descriptive and inferential statistics. Knupfer and McLellan (1996) argued that descriptive statistics inform us on what is while inferential statistics bring out cause and effect. Descriptive statistics were analyzed using frequencies, percentages, the mean-measures of central tendency, and Standard deviation, which is the measure of dispersion. Inferential statistics were also analyzed, to show correlation between variables. Statistical Package for Social Sciences (SPSS) version 18 was used to analyse data. The results were presented using tables and pie charts.

A multiple linear regression model was adopted as shown:

$Y = \alpha + \beta\ 1X1 + \beta\ 2X2 + \beta\ 3X3 + e$

Where:

Y= Drought Mitigation and Management

α =Regression constant

β 1=Coefficient of Information Quality

β 2=Coefficient of System Quality

β 3=Coefficient of Service Quality

X1=Information Quality

X2=System Quality

X3=Service Quality

e=Error term

All the statistical tests were conducted at 1% level of significance (99% confidence level). The significance of relationships was tested at 1% level of significance.

3.10 Limitations of methodology

Research methodology is the pillar of a research (Saunders et al. 2009). The main purpose of Quantitative study is the data quantification that permits generalizations of the outcomes by measuring the views and responses of the target sample. According to (Younus, 2014) every study methodology is made up of two wide phases that are planning and execution. Hence, it is apparent that inside these two phases, it is probable to have restrictions that are afar our power (Simon 2011). The study had the following limitations:

3.9.1 Lack of enough time and resources to collect data. It was a big challenge to collect data from the 23 ASAL Counties.

3.9.2 Inability to control the environment e.g. it was difficult getting information without prior approval from relevant government agencies.

CHAPTER FOUR

RESULTS, DISCUSSIONS AND SUMMARY OF FINDINGS

4.1 Introduction

This chapter presents data analysis and findings of the research as stated in the research methodology. The data was presented in form of tables and charts for the purpose of simplicity. The data collection process was carried out in 23 ASALs, and the data was used to examine the Effects of DEWs in drought mitigation and management in ASALs in Kenya.

4.2 Pilot Results

Before testing for correlation of the study variables, it was important to know the level of their reliability. The measurement reliability was conducted using Cronbach's alpha coefficient and for an alpha of between 0.70 and 0.95, the instrument was interpreted as reliable (Bland and Altman, 1997). The internal consistency of the variables is acceptable since it was more than 0.70. The alpha level also shows that the variables of the study were correlated. The value of Cronbach's Alpha confirms that the variables used for the study had an internal consistency of 0.77 which falls within the recommended threshold.

Table 2 Reliability Statistics using Cronbach's alpha

Cronbach's Alpha	Cronbach's Alpha Based on Standardized Items	N of Items
.77	.075	4

4.3 Response Rate

One hundred and fifteen (115) questionnaires were issued to users from the 23 ASAL Counties that formed the sample size. Out of these, eighty eight (88) questionnaires were returned. These represented 77% response rate. According to Mugenda and Mugenda (2003), a response rate of 50% is adequate for a study.

4.4 Preliminary Question

Table 4 Have you ever used DEWs

Have you ever used DEWS?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	88	100.0	100.0	100.0

All the participants confirmed to have used DEWS. The use of purposive sampling ensured that the right population was targeted.

4.5 Demographic Information

This segment contains universal information about the respondents and their organizations. The data showed the appropriateness of the respondent in participating in the research process.

4.5.1 Age of the Respondents

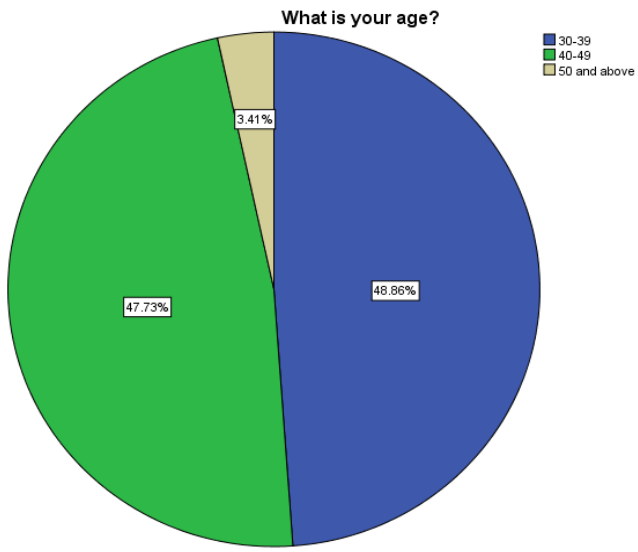
The tabulation shows that the highest percentage of the respondents who took part in the study was aged between 30 and 39 years representing 48.9%. Those aged between 40 and 49 years came second representing 47.7% of the total respondents. Those above 50 represent 3.4% of the population.

Table 5 Age of respondents

What is your age?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	30-39	43	48.9	48.9	48.9
	40-49	42	47.7	47.7	96.6
	50 and above	3	3.4	3.4	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



4.5.2 Gender of the Respondents

The analysis showed that 70.5% of the participants were men and 29.5% were women. The table below represents the information above.

Table 6 Gender of respondents

What is your gender?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	62	70.5	70.5	70.5
	Female	26	29.5	29.5	100.0
	Total	88	100.0	100.0	

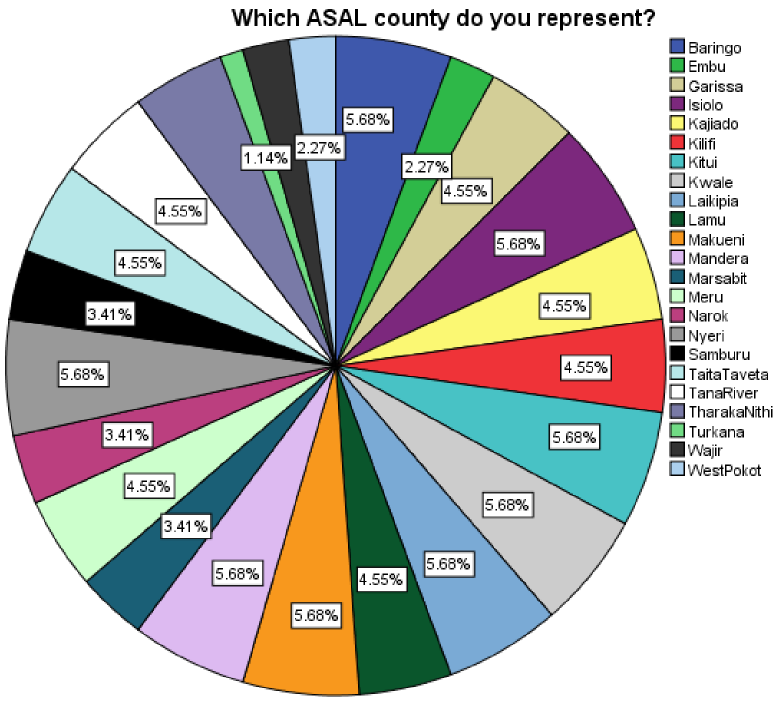
4.5.3 Respondents County of Representation

The table below indicates that apart from Embu, Turkana, Wajir, and West Pokot, other counties had more than two participants. The maximum number of participants from all the counties was five.

Table 7 Respondents County of representation

Which ASAL county do you represent?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Baringo	5	5.7	5.7	5.7
	Embu	2	2.3	2.3	8.0
	Garissa	4	4.5	4.5	12.5
	Isiolo	5	5.7	5.7	18.2
	Kajiado	4	4.5	4.5	22.7
	Kilifi	4	4.5	4.5	27.3
	Kitui	5	5.7	5.7	33.0
	Kwale	5	5.7	5.7	38.6
	Laikipia	5	5.7	5.7	44.3
	Lamu	4	4.5	4.5	48.9
	Makueni	5	5.7	5.7	54.5
	Mandera	5	5.7	5.7	60.2
	Marsabit	3	3.4	3.4	63.6
	Meru	4	4.5	4.5	68.2
	Narok	3	3.4	3.4	71.6
	Nyeri	5	5.7	5.7	77.3
	Samburu	3	3.4	3.4	80.7
	TaitaTaveta	4	4.5	4.5	85.2
	TanaRiver	4	4.5	4.5	89.8
	TharakaNithi	4	4.5	4.5	94.3
	Turkana	1	1.1	1.1	95.5
	Wajir	2	2.3	2.3	97.7
	WestPokot	2	2.3	2.3	100.0
	Total	88	100.0	100.0	



4.5.4 Respondents Ministry, Department or County of Representation

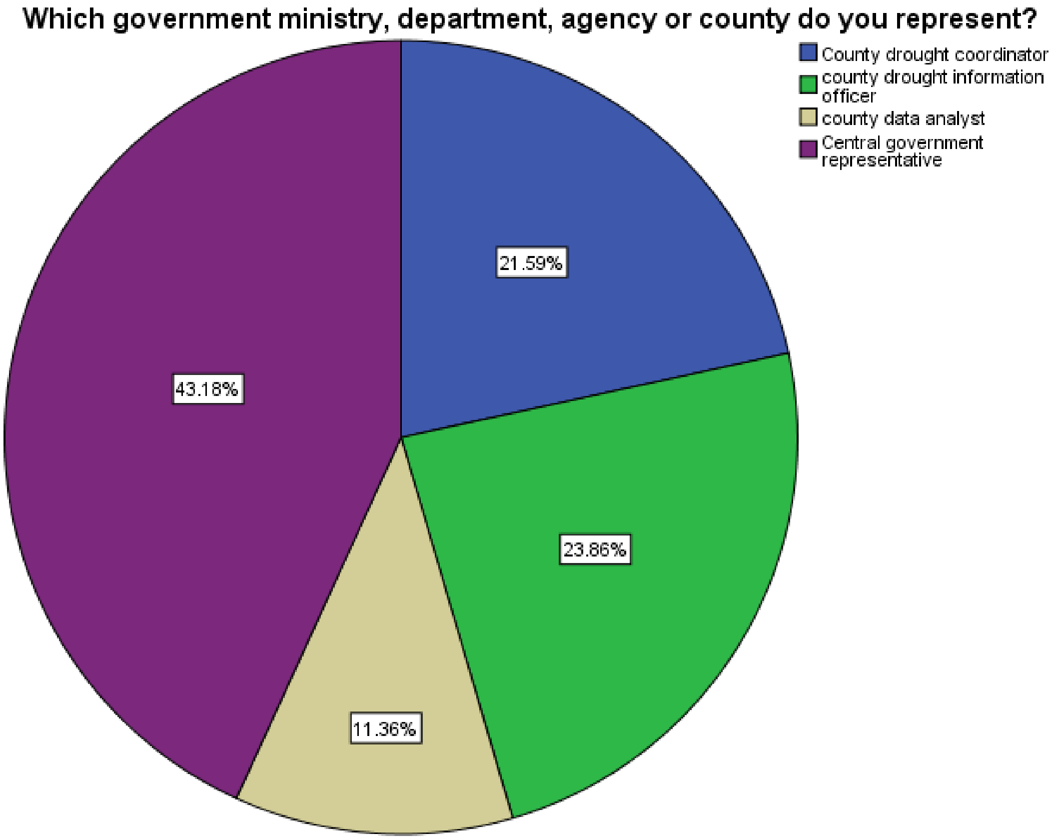
The table below indicates that 22.7% of the respondents were County government representative, 20.5% were Central government representative while 23.9% were County drought information officers, 21.6% were County drought coordinators and 11.4% were County data analyst.

Table 8 Respondents Ministry, Department or County of representation

Which government ministry, department, agency or county do you represent?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	County Drought Coordinator	19	21.6	21.6	21.6
	County Drought Information Officer	21	23.9	23.9	45.5
	County Data Analyst	10	11.4	11.4	56.8
	Central Government Representative	18	20.5	20.5	77.3
	County Government Representative	20	22.7	22.7	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



4.5.5 Respondents duration of using DEWs

The table below indicates that 51.1% of the participants confirmed to have used DEWS for a period of 3 to 4 years. Those who had used DEWS for 5 years and above came second representing 34.1% of the total participants.

Table 9 Respondents Period of using DEWS

How long have you used DEWS?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	1 to 2 years	13	14.8	14.8	14.8
	3 to 4 years	45	51.1	51.1	65.9
	5 years and above	30	34.1	34.1	100.0
	Total	88	100.0	100.0	

4.5.6 Mediums used to disseminate DEWS Information

a) County Steering Group (CSG)

The table above indicates that 98.9% of the participants use CSG as a medium to disseminate DEW information.

Table 10 CSG as a medium of disseminating DEWS

Do you use CSG as a medium to disseminate DEW information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	87	98.9	98.9	98.9
	No	1	1.1	1.1	100.0
	Total	88	100.0	100.0	

b) Community Barazas

The table below shows that 98.9% of the respondents use community Barazas as a medium to disseminate DEW information in their country.

Table 11 Community Barazas as a medium of disseminating DEWS

Do you use Community Barazas as a medium to disseminate DEW information in your county?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	87	98.9	98.9	98.9
	No	1	1.1	1.1	100.0
	Total	88	100.0	100.0	

c) Whatsapp Groups

The table below indicates that 68.2% of the participants do not use WhatsApp as a medium to disseminate DEW information in their county. 31.8% use WhatsApp for information dissemination.

Table 12 Whatsapp groups as a medium of disseminating DEWS

Do you use WhatsApp as a medium to disseminate DEW information in your county?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Yes	28	31.8	31.8	31.8
	No	60	68.2	68.2	100.0
	Total	88	100.0	100.0	

d) SMS Alerts

The table below clearly shows that SMS alerts is not used as a medium to disseminate DEW information in any of the respondent's county.

Table 13 Whatsapp groups as a medium of disseminating DEWS

Do you use SMS alerts as a medium to disseminate DEW information in your county?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	No	88	100.0	100.0	100.0

4.6 Drought Early Warning System

4.6.1 Information Quality

a) DEW system provided accurate information

The table below indicates that 64.8% of the participants strongly agreed that DEW system provides accurate information. 35.2% also agree on the same.

Table 14 DEW system provided accurate information

DEW system provided accurate information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	31	35.2	35.2	35.2
	strongly agree	57	64.8	64.8	100.0
	Total	88	100.0	100.0	

e) DEW system provided relevant information

The table below indicates that 60.2% of the participants strongly agreed that DEW system provides relevant information. 39.8% also agreed on the same. The bar graph below represents the information in the table above.

Table 15 DEW system provides relevant information

DEW system provides relevant information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	35	39.8	39.8	39.8
	strongly agree	53	60.2	60.2	100.0
	Total	88	100.0	100.0	

b) DEW system provided up to date information

The table below shows that the highest percentage of the respondents strongly agreed that DEW provides up to date information. They were 55.7% of the total number of respondents. 44.3% of the respondents also agreed on the same.

Table 16 DEW system provide up to date information

DEW provides up to date information

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	39	44.3	44.3	44.3
	strongly agree	49	55.7	55.7	100.0
	Total	88	100.0	100.0	

4.6.2 System Quality

a) DEW system is user friendly

The table below shows that 61.4% of the respondents strongly agreed and 38.6% agreed that DEW system is user friendly.

Table 17 DEW system is user friendly

DEW system is user friendly

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	34	38.6	38.6	38.6
	strongly agree	54	61.4	61.4	100.0
	Total	88	100.0	100.0	

b) DEW System is easy to use

The table below indicates that 52.3% strongly agreed and 47.7% agreed that DEW system is easy to use.

Table 18 DEW system is easy to use

DEW system is easy to use

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	42	47.7	47.7	47.7
	strongly agree	46	52.3	52.3	100.0
	Total	88	100.0	100.0	

c) Is the DEW system stable

The table below indicates that 67% agreed and 21.6% strongly agreed that DEW system is stable. However, 11.4% of the participants were neutral on the same.

Table 19 DEW system is Stable

Is the DEW system stable?

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	10	11.4	11.4	11.4
	Agree	59	67.0	67.0	78.4
	strongly agree	19	21.6	21.6	100.0
	Total	88	100.0	100.0	

4.6.3 Service Quality

a) DEW system is available all the time

The table below indicates that 45.5% of the respondents agreed, 43.2% strongly agreed, while 11.4% were neutral that DEW system is available all the time.

Table 20 DEW system is Stable

DEW system is available all the time

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	10	11.4	11.4	11.4
	Agree	40	45.5	45.5	56.8
	strongly agree	38	43.2	43.2	100.0
	Total	88	100.0	100.0	

b) DEW system is always responsive

The table below shows that 68.2% of the respondents agreed, 21.6% strongly agreed, while 10.2% were neutral that DEW system is always responsive.

Table 21 DEW system is always responsive

DEW system is always responsive

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	9	10.2	10.2	10.2
	Agree	60	68.2	68.2	78.4
	strongly agree	19	21.6	21.6	100.0
	Total	88	100.0	100.0	

c) DEW system is reliable always

The table below indicates that 72.7% of the respondents agreed, 8% strongly agreed, 18.2% were neutral, and 1.1% disagreed that DEW system is reliable always.

Table 22 DEW system is reliable always

DEW system is reliable always

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Disagree	1	1.1	1.1	1.1
	Neutral	16	18.2	18.2	19.3
	Agree	64	72.7	72.7	92.0
	strongly agree	7	8.0	8.0	100.0
	Total	88	100.0	100.0	

4.7 Drought Contingency Planning

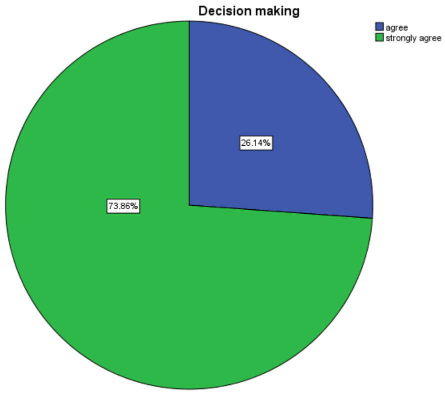
The table below shows that 73.9% of the respondents strongly agreed while 26.1% agreed that DEWs has improved decision making during preparation of drought contingency plans.

Table 23 DEW system enhances decision making

Decision making

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	23	26.1	26.1	26.1
	strongly agree	65	73.9	73.9	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



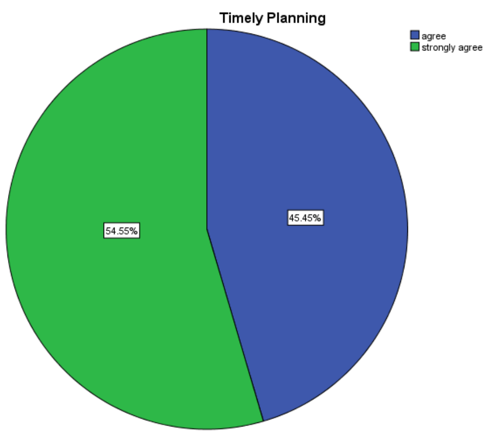
The table below indicated that the highest percentage of the total respondents which was 54.5% strongly agreed that DEWs has enabled timely planning. The remaining percentage agreed on the same too.

Table 24 DEW system has enabled timely planning

Timely Planning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	40	45.5	45.5	45.5
	strongly agree	48	54.5	54.5	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



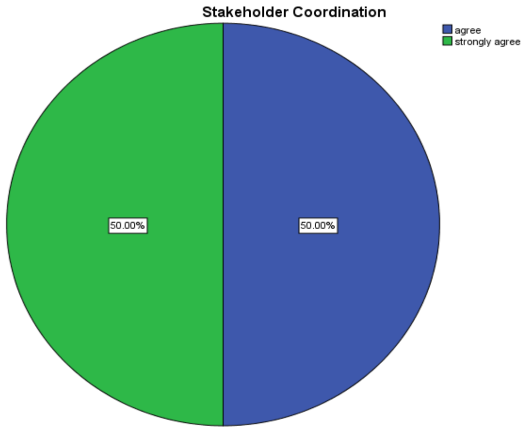
The table below shows that half of the population agreed that stakeholder coordination has been fostered by the system. The other half strongly agreed on the same.

Table 25 DEW system has enhanced stakeholder coordination

Stakeholder Coordination

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	44	50.0	50.0	50.0
	strongly agree	44	50.0	50.0	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



4.8 Drought Mitigation Strategies

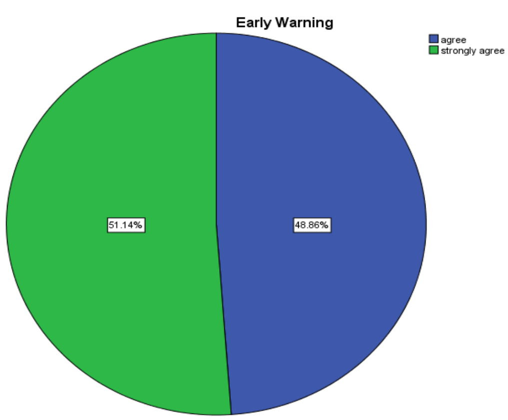
The table below shows that 51.1% of the participants strongly agreed that the system gives early warning. The remaining percentage agreed on the same.

Table 26 DEW system has enhanced timely planning

Early Warning

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Agree	43	48.9	48.9	48.9
	strongly agree	45	51.1	51.1	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



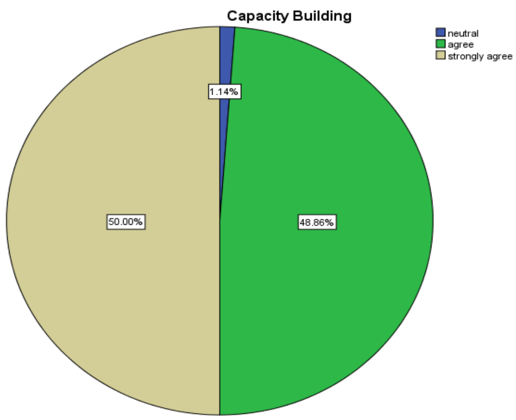
The table below shows that 50% strongly agreed, 48.9% agreed, and 1.1% of the respondents were neutral about the issue of capacity building.

Table 26 DEW system has enhanced capacity building

Capacity Building

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	1	1.1	1.1	1.1
	Agree	43	48.9	48.9	50.0
	strongly agree	44	50.0	50.0	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



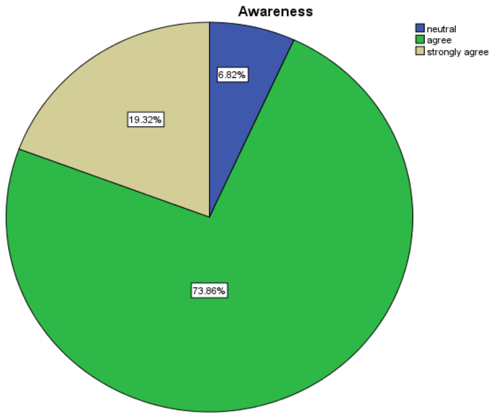
The table below shows that 19.3% strongly agreed, 73.9% agreed, and 6.8% of the respondents were neutral about the issue of awareness.

Table 26 DEW system has improved awareness

Awareness

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	6	6.8	6.8	6.8
	Agree	65	73.9	73.9	80.7
	strongly agree	17	19.3	19.3	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



4.9 Drought Risk Management

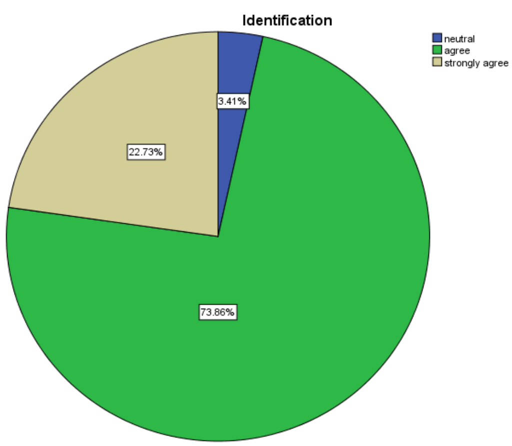
The table below shows that 22.7% strongly agreed, 73.9% agreed, and 3.4% of the respondents were neutral about the issue of identification.

Table 27 DEW system has improved drought risk identification

Identification

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	3	3.4	3.4	3.4
	Agree	65	73.9	73.9	77.3
	strongly agree	20	22.7	22.7	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



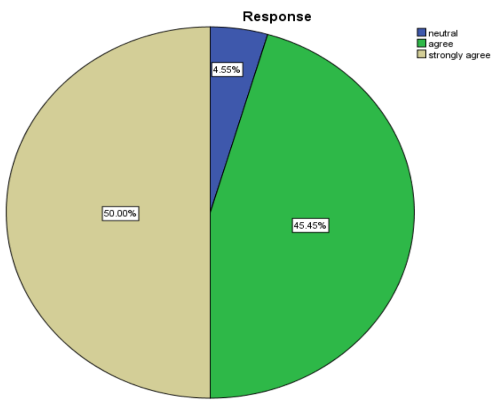
The table below shows that 50% strongly agreed, 45.5% agreed, and 4.5% of the respondents were neutral about the issue of response.

Table 28 DEW system has ensured rapid response

Response

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	4	4.5	4.5	4.5
	Agree	40	45.5	45.5	50.0
	strongly agree	44	50.0	50.0	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



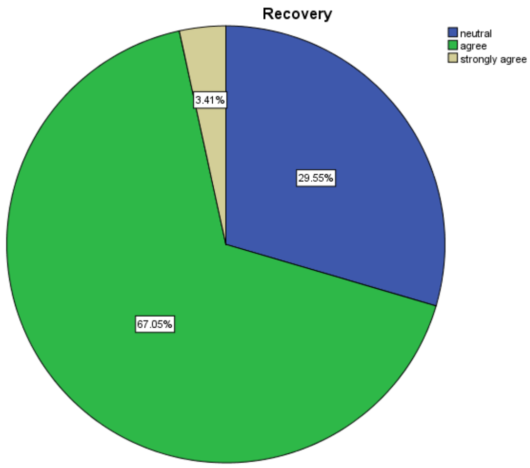
The table below shows that 3.4% strongly agreed, 67% agreed, and 29.5% of the respondents were neutral about the issue of recovery.

Table 28 DEW system has ensured recovery

Recovery

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Neutral	26	29.5	29.5	29.5
	Agree	59	67.0	67.0	96.6
	strongly agree	3	3.4	3.4	100.0
	Total	88	100.0	100.0	

The pie chart below represents the information in the table above.



4.10 Correlation Analysis

A significance level of 0.01 was used for all the tests.

Table 29 Correlations between independent and dependent variables

Correlations

		Information Quality	System Quality	Service Quality	Drought Mitigation and Management
Information Quality	Pearson Correlation	1	.036	.187	.414**
	Sig. (2-tailed)		.740	.081	.000
	N	88	88	88	88
System Quality	Pearson Correlation	.036	1	.366**	.495**
	Sig. (2-tailed)	.740		.000	.000
	N	88	88	88	88
Service Quality	Pearson Correlation	.187	.366**	1	.735**
	Sig. (2-tailed)	.081	.000		.000
	N	88	88	88	88
Drought Mitigation and Management	Pearson Correlation	.414**	.495**	.735**	1
	Sig. (2-tailed)	.000	.000	.000	
	N	88	88	88	88

**. Correlation is significant at the 0.01 level (2-tailed).

Pearson's moment correlation was utilized to check the level of correlation among the independent variable and dependent variables. The results indicate that there is a sturdy positive linear relationship among the variables. An increase in an independent variable will cause an augment in the dependent variable. On top, the correlation is considerable at 0.01 level (2-tailed).

H1: DEW system provides relevant information for decision making since they have a statistically linear relationship and also the Pearson correlation coefficient for the two is .292, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 30 Correlations for hypothesis 1

Correlations

		DEW system provides relevant information	Decision making
DEW system provides relevant information	Pearson Correlation	1	.113
	Sig. (2-tailed)		.292
	N	88	88
Decision making	Pearson Correlation	.113	1
	Sig. (2-tailed)	.292	
	N	88	88

H2: DEW system provides accurate information for early warning since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .343, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 31 Correlations for hypothesis 2

Correlations

		DEW system provided accurate information	Early Warning
DEW system provided accurate information	Pearson Correlation	1	.102
	Sig. (2-tailed)		.343
	N	88	88
Early Warning	Pearson Correlation	.102	1
	Sig. (2-tailed)	.343	
	N	88	88

H3: DEW system provides up to date information for timely identification of drought risks since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .256, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 32 Correlations for hypothesis 3

Correlations

		DEW provides up to date information	Identification
DEW provides up to date information	Pearson Correlation	1	.122
	Sig. (2-tailed)		.256
	N	88	88
Identification	Pearson Correlation	.122	1
	Sig. (2-tailed)	.256	
	N	88	88

H4: DEW system is user friendly and allows timely planning of drought contingency plans since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .0.46, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 33 Correlations for hypothesis 4

Correlations

		DEW system is user friendly	Timely Planning
DEW system is user friendly	Pearson Correlation	1	.213*
	Sig. (2-tailed)		.046
	N	88	88
Timely Planning	Pearson Correlation	.213*	1
	Sig. (2-tailed)	.046	
	N	88	88

*. Correlation is significant at the 0.01 level (2-tailed).

H5: DEW system is easy to use and increases stakeholder coordination since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .399, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 33 Correlations for hypothesis 5

Correlations

		DEW system is easy to use	Stakeholder Coordination
DEW system is easy to use	Pearson Correlation	1	.091
	Sig. (2-tailed)		.399
	N	88	88
Stakeholder Coordination	Pearson Correlation	.091	1
	Sig. (2-tailed)	.399	
	N	88	88

H6: DEW system is stable and ensures timely response to drought mitigation efforts since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .209, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 34 Correlations for hypothesis 6

Correlations

		Is the DEW system stable?	Response
Is the DEW system stable?	Pearson Correlation	1	.135
	Sig. (2-tailed)		.209
	N	88	88
Response	Pearson Correlation	.135	1
	Sig. (2-tailed)	.209	
	N	88	88

H7: DEW system is always available and ensures timely planning of drought contingency plans since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .013, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 35 Correlations for hypothesis 7

Correlations

		DEW system is available all the time	Timely Planning
DEW system is available all the time	Pearson Correlation	1	.265*
	Sig. (2-tailed)		.013
	N	88	88
Timely Planning	Pearson Correlation	.265*	1
	Sig. (2-tailed)	.013	
	N	88	88

*. Correlation is significant at the 0.01 level (2-tailed).

H8: DEW system is always responsive and ensures dissemination of early warning bulletins since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .966, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 36 Correlations for hypothesis 8

Correlations

		DEW system is always responsive	Early Warning
DEW system is always responsive	Pearson Correlation	1	.305
	Sig. (2-tailed)		.966
	N	88	88
Early Warning	Pearson Correlation	.305	1
	Sig. (2-tailed)	.966	
	N	88	88

H9: DEW system is reliable and ensures swift response to drought risk management efforts since they have a statistically linear relationship. The Pearson correlation coefficient for the two is .006, which is significant for two-tailed test. Also, the direction of relationship is positive.

Table 37 Correlations for hypothesis 9

Correlations

		DEW system is reliable always	Response
DEW system is reliable always	Pearson Correlation	1	.289**
	Sig. (2-tailed)		.006
	N	88	88
Response	Pearson Correlation	.289**	1
	Sig. (2-tailed)	.006	
	N	88	88

**. Correlation is significant at the 0.01 level (2-tailed).

4.10 Regression Analysis

Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.827[a]	.684	.673	1.17371

a. Predictors: (Constant), Service Quality, Information Quality, System Quality

The coefficient of determination value indicates that 68.4% of the variability in the dependent variable can be explained by the X variables. The R figure shows that the association among the independent and the dependent variable is positive. R square shows that the strength of the relationship between the model and the response variable is strong enough to help one to make important finale regarding how alterations in the predictor values relate to changes in the reaction value.

ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	250.601	3	83.534	60.638	.000[b]
	Residual	115.717	84	1.378		
	Total	366.318	87			

a. Dependent Variable: Drought Mitigation and Management

b. Predictors: (Constant), Service Quality, Information Quality, System Quality

This table shows that the regression model that predicts the dependent variable considerably well. The "**Sig.**" column shows the statistical implication of the regression model run, showing that the level of significance is 0.00%. This means that the conceptual framework is significant in explaining the effect of DEWs in drought mitigation and management.

Coefficients[a]

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	12.271	2.425		5.060	.000
	Information Quality	.652	.137	.296	4.744	.000
	System Quality	.531	.129	.272	4.126	.000
	Service Quality	.893	.103	.580	8.654	.000

a. Dependent Variable: Drought Mitigation and Management

Drought mitigation and management can be calculated using the independent variables as shown below:

$$\mathbf{Y = 12.271 + 0.652\ X_1 + 0.531\ X_2 + 0.893\ X_3}$$

Where Y is Drought Mitigation and Management, X1 is Information Quality, X2 is System Quality, and X3 is Service Quality. The results in the table above for regression coefficients of the study shows that there is a optimistic relation among Information, System and Service Quality and Drought Mitigation and Management, as supported by beta coefficients of 0.652, 0.531, and 0.893 respectively. This implies that an increment in any of these variables will positively influence Drought Mitigation and Management. The analysis also brings out results that indicate that all variables used in the research are statistically relevant, as the probability values of the variables are 0.00. This shows that there is enough evidence from the respondents' sample to conclude that a non-zero correlation exists, again, supporting the existence of a relationship between the variables.

4.11 Summary and Interpretation of the findings

The study was aimed at establishing how DEWs has enhanced drought mitigation and management in ASALs in Kenya. It was guided by objectives which focused on establishing the effect information quality of the DEWS has on drought contingency planning, assessing the influence system quality of DEWS has on drought mitigation strategies and finally to ascertain the effect service quality of DEWS has on drought risk management.

4.11.1 DEWS and Drought Contingency Planning

The first objective was to analyze the effect information quality DEWS has on drought contingency planning in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya. The study revealed that information quality of the DEW system has enabled provision of relevant information required for drought contingency planning with 60.2% of users strongly agreeing. Further, 73.9 % of the respondents strongly agreed that DEW has improved decision making during preparation of drought contingency plans while 26.1% agreed. This clearly shows that DEWs has enabled relevant stakeholders to respond to drought threats swiftly due to availability of information. The study also established that 64.8% strongly agreed that DEW system provides accurate information required for early warning. This has enabled timely planning with 54.5% of respondents strongly agreeing while 45.5% agreeing. 61.4% strongly agreed and 38.6% agreed that DEW System user friendliness has brought about efficiency and timely planning of drought contingency plans. The study also revealed that 43.2% strongly agreed that the availability of DEW System has ensured timely planning of drought contingency plans. Half of the respondents 50% strongly agreed that stakeholder coordination has been fostered by the DEWs. The other half 50% agreed on the same, this clearly shows that the use of the system has improved how stakeholders address issues of drought. This is achieved through collaboration during CSG, workshops, Barazas and other community forums.

4.11.2 DEWS and Drought Mitigation Strategies

The second objective sought to assess the influence system quality of DEWS has on drought mitigation strategies. The study revealed that 61.4% of users strongly agreed that DEWs is user friendly. The study further established that DEW System ease of use has ensured usability and ultimately enhanced capacity building for all relevant stakeholders. This is backed by the number of respondents at 52.3% who strongly agreed and 47.7% who agreed that the DEWs is easy to use. The study also revealed that responsiveness of DEW System has enhanced dissemination of early warning bulletins. This has ensured that communities living in ASALs receive drought early warning bulletins on time. The study has also revealed that 21.6% strongly agreed that DEWs is stable, 67% agreed while 11.4% of the respondents were neutral. This clearly indicates that stability of DEWS is not across board in all the ASAL Counties. The 11.4% of the neutral respondents shows that there some element of instability in some Counties. Nevertheless, the stability of DEWs has ensured timely response to drought mitigation strategies by providing early warning without interference with 51.1% of respondents strongly agreeing.

4.11.3 DEWS and Drought Risk Management

The third objective sought to ascertain the effect service quality of the DEWS has on drought risk management. The study has revealed that availability of DEWs has enabled timely identification of drought risks this is affirmed by 43.2% of users strongly agreeing that the DEWs is available all the time while 45.5% agree on the same and 11.4% were neutral. The 11.4% of the neutral respondents shows that some Counties are experiencing unavailability of the DEWs. This may be caused by poor ICT infrastructure or lack of enough capacity. The study further revealed that responsiveness of the DEW System has ensured on time response to drought risk mitigation efforts. This is affirmed by 21.6% of the respondents who strongly agreed that the system is always responsive, 68.2% agreed on the same while 11.2% were neutral. The study also assessed the reliability of DEW System with 8% strongly agreeing, 72.7% agreeing while 18.2% were neutral and 1.1% totally disagreed that the DEWs is reliable. This result shows that the system is yet to exhibit its full potential in some Counties. Lastly the study has revealed that not all respondents agree that the DEWs has ensured recovery efforts with 29.5% being neutral.

CHAPTER FIVE

CONCLUSIONS AND RECOMMENDATIONS

5.1 Introduction

This section presented the discussion synopsis of key outcomes, conclusion, recommendations of the research and highlights for more research. The conclusion and recommendations got were aimed towards addressing the purpose of the research which was to review the outcomes of Drought Early Warning System in drought mitigation and management in ASALs in Kenya. The various sections presented in this chapter are based on the research goals which were: to analyze the effect information quality of DEWS has on drought contingency planning in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya, to assess the influence system quality of DEWS has on drought mitigation strategies in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) in Kenya and to ascertain the effect service quality of DEWS has on drought risk management in Drought Mitigation and Management in Arid and Semi-Arid Lands (ASALs) Kenya.

5.2 Summary of findings

The purpose of this research was to assess the effects of Drought Early Warning System in drought mitigation and management in ASALs in Kenya. The study found out that DEW system provides relevant information that has enhanced decision making during preparation of drought contingency plans. User friendliness of the system has ensured efficiency and timely planning of drought contingency plans. The availability of DEWs has also improved stakeholder coordination hence proper dissemination of early warning bulletins through various mediums of communication.

The study further found out that DEWs provides accurate information thus enhancing the provision of early warning necessary for drought mitigation. The system ease of use has enhanced capacity building among stakeholders especially communities living in the ASALs. The system's ability to be responsive has ensured on time dissemination of drought early warning bulletins. According to Wilhite, Sivakumar and Wood (2000), a key element of planning for famine is the availing of appropriate and dependable climate data such as seasonal forecasts that helps policy makers at all stages in making key management decisions. The DEWs has enabled NDMA and other stakeholders make crucial and timely decisions for better drought management.

The study also found out that the DEWs provides up to date information thus enabling easy identification of drought risks and ensure action is taken appropriately. From the findings of the study, not all users resoundingly agreed that the system is stable. This is attributed to the fact that not all ASALs Counties have proper ICT infrastructure to support full functionality of the DEWs. For the Counties that experience stability of the system, there is on time response that has subsequently improved drought risk mitigation efforts. This coincides with Ibrahim (2016) argument that many famine contingency plans are reaction oriented and have limited emphasis on alleviation.

The study finally concludes that DEWs being a critical component of drought mitigation and management has enabled timely provision of up to date information. We can conclude that DEWS would diminish drought threats by ensuring on time response to drought threats.

5.3 Recommendations

There is need for sensitization of communities living in ASAL through information distribution workshops and capacity development on the importance of implementing DEW information. The concerned government agencies like NDMA needs to take a leading role in civic education and develop a common public engagement framework that recognizes the role of community participation in ensuring drought early warning bulletins are acted upon.

There is a need to improve the ICT infrastructure in some ASAL Counties. The study revealed that some ASAL Counties like Wajir, Turkana and Marsabit their ICT infrastructure is very poor thus hindering the full functionality of the DEWs. The Government should hasten the completion of National Fibre Optic Backbone (NOFBI) and Phase II of County Connectivity Project (CCP) to ensure all Counties especially the ASALs have proper ICT infrastructure.

The study has also established that some Counties do not have substantial CSG. The CSG is a committee mandated by the Government to coordinate issues of drought mitigation and management at the County level. This has hindered drought mitigation and coordination efforts in some Counties. The study recommends the appointment of CSG in all the Counties which do not have substantial committees. This will enhance drought mitigation efforts most importantly the ASAL Counties.

The study also recommends that the government integrate DEWs with Drought Contingency Fund to finance drought affected communities living in ASAL Counties. The integration will enhance fast identification of drought prone areas and facilitate early response to drought threats.

Given the elevated occurrence of droughts and its linked effects on food safety in Kenya DEWs must to be introduced to other parts experiencing food insecurity that have not been gazetted as ASAL. The experts of DEWS should put together pasture protection, and use of drought resistant seeds as a measure of building the capacity of people living in ASALs in dealing with the problems of extended drought.

Lastly, food security being a crucial component of the big 4 agenda, the study recommends more funds should be allocated to NDMA and other relevant agencies to improve the DEWs. This will ensure the government's commitment on food security is achieved through proper drought mitigation strategies.

5.4 Suggestions for future research

It is evident from the study that it is necessary to conduct further studies to assess the effects of DEWS on household food security in ASALs in Kenya. This study will be of significant importance of one of the big four agenda on food security. Another study might consider assessing the impact of DEWs on the newly gazetted 29 ASALs.

References

Akinnagbe O.M and Irohibe I. J, (2014). Agricultural adaptation strategies to climate change impacts in africa: a review,

Anja Klisch and Clement Atzberger (2016). Remote Sensing; Operational Drought Monitoring in Kenya Using MODIS NDVI Time Series,

Alexandre J., Isaías P. (2012) Information Systems Success: Measuring Wiki Implementation Success, Based on the DeLone & McLean Model,

Belief Action Outcome Model. (n.d.). Retrieved March 06, 2018 from https://is.theorizeit.org/wiki/Belief_Action_Outcome_Model,

Rahman H., Mesquita A., Ramos I., Pernici B. (eds) Knowledge and Technologies in Innovative Information Systems. Lecture Notes in Business Information Processing, vol 129. Springer, Berlin, Heidelberg

Basics, Drought and What Drought?. "What Is Drought?" Drought.unl.edu. N.p., 2017. Web. 28 Jan. 2017.

B. Shiferaw, K. Tesfaye, M. Kassie, T. Abate ,B.M. Prasanna, A. Menkir (2014). Managing vulnerability to drought and enhancing livelihood resilience in sub-Saharan Africa: Technological, institutional and policy options,

Bikram Pal Kaur and Himanshu Aggrawal, (2013). Exploration of Success Factors of Information System; IJCSI International Journal of Computer Science Issues, Vol. 10, Issue 1, No 2, January 2013, Donald A. Wilhite, M.V.K. Sivakumar and Deborah A. Wood (Eds.) (2000). Early Warning Systems for Drought Preparedness and Drought Management,

Donald A. Wilhite, M. Hayes, C. Knutson, K.H. Smith (2000). Planning for Drought; Moving from crises to risk management,

Donald A. Wilhite, Mark D. Svoboda and Michael J. Hayes (2007). Understanding the complex impacts of drought: A key to enhancing drought mitigation and preparedness,

Dua' A. Nassar , Marini Othman, Jamal A. Hayajneh, Nor'ashikin Alia (2014). An Integrated Success Model for an Electronic Health Record: A case study of Hakeem Jordan; Procedia Economics and Finance 23 (2015) 95 – 103,

D. Akwango, B. Obaa1, N. Turyahabwe1, Y. Baguma and A. Egeru (2017). Effect of drought early warning system on household food security in Karamoja subregion, Uganda.

E. Mbogo, F. Inganga and J.M. Maina, (2014). Drought conditions and management strategies in Kenya,

F. Opiyo, O. Wasonga, M. Nyangito, J. Schilling and R. Munang (2015). Drought Adaptation and Coping Strategies among the Turkana Pastoralists of Northern Kenya;

G. Naumann1, P. Barbosa1, L. Garrote2, A. Iglesias3, and J. Vogt1 (2014). Exploring drought vulnerability in Africa: an indicator based analysis to be used in early warning systems;

G.O Muhua, J.K Waweru (2017). Influence of Drought Mitigation Strategies on Food Security: A Case of Laikipia East, Laikipia County, Kenya- European Scientific Journal, ESJ.

"Government Launches A Shs.8.3 Billion Food Project for Drought-Prone Counties | Kenya News Agency". Kenyanewsagency.go.ke. N.p., 2017. Web. 24 Mar. 2017,

GoK August, (2012). Programming Framework to End Drought Emergencies in the Horn of Africa; Country Programme Paper Ending drought emergencies in Kenya,

Jason A. Otkin (2015). Facilitating the Use of Drought Early Warning Information through Interactions with Agricultural Stakeholders,

John K. Waweru (2016). Influence of drought mitigation strategies on food security: a case of Laikipia east, Laikipia county, Kenya,

Hu, P. J. Evaluating Telemedicine Systems Success (2002). A Revised Model. Proceedings of the 36th Hawaii International Conference on System Sciences (HICSS'03) IEEE 76

Joseph E. Quansah, Bernard Engel, and Gilbert L. Rochon (2010). Early Warning Systems: A Review; the Journal of Terrestrial Observation | Volume 2 Number 2,

Li Xiao and Subhasish Dasgupta (2002); measurement of user satisfaction with web-based information systems: an empirical study; Eighth Americas Conference on Information Systems

Michael Hayes, Mark Svoboda, Nicole Wall, and Melissa Widhal.M (2011). *American Meteorological Society;* The Lincoln Declaration On Drought Indices; Universal Meteorological Drought Index Recommended,

M. Brewer, T. Owen, R. Pulwarty, and M. Svoboda (2006). National Integrated Drought Information System (NIDIS); a model for interagency climate services collaboration,

Mugenda, O. M., & Mugenda, A. G. (2012). Research methods dictionary,

Muthoni Masinde (2015). African Journal of Science, Technology, Innovation and Development; An innovative drought early warning system for sub-Saharan Africa: integrating modern and indigenous approaches P. 8 - 25

NDMA (2014). Ending Drought Emergencies: Common Programme Framework for Drought Risk Management,

N. Melville & M. Ross, (2010). MIS Quarterly; Information systems innovation for environmental sustainability;

Ochola, Abiya. (2017). "National Drought Early Warning Bulletin - January 2017". Ndma.go.ke. N.p., 2017. Web. 28 Jan. 2017,

Otieno Ibrahim, (2016). Citizen-Centric Model for Evaluating the Intermediate Impact of Egovernment: A Case Study of Huduma Centres in Kenya,

Roger S. Pulwarty and Mannava V.K. Sivakumar (2014). Information systems in a changing climate: Early warnings and drought risk management,

Stefan Cronholm and Göran Goldkuhl (2003). Department of Computer and Information Science, Strategies for information system evaluation, Stacie P, W. DeLone, E. McLean (2008). Measuring information systems success: models, dimensions, measures and interrelationships; European Journal of Information Systems 17, 236–263

UN/ISDR (2007). Drought Risk Reduction Framework and Practices: Contributing to the Implementation of the Hyogo Framework for Action,

Wen-Cheng Huang, Lun-Chin Yuan' (2004). A drought early warning system on real-time multireservoir operations

W. H. DeLone and E. R. McLean (2016). Information Systems Success Measurement. Foundations and Trends R in Information Systems, vol. 2, no. 1, pp. 1–116.

APPENDICES

Appendix I: Introductory Letter

Dear Respondent,

RE: RESEARCH DATA COLLECTION

I am a postgraduate student at the University of Nairobi pursuing a Master of Science degree in Information Technology Management (Msc. ITM). I am currently collecting data for my research project titled: Effects of Drought Early Warning System in drought mitigation and management in Arid and Semi-Arid Lands (ASALs) in Kenya.

The purpose of this letter is to humbly request you to create time and answer the questions in the questionnaire attached.

Kindly read the accompanying instructions and respond to the questions. If need be, you may provide any documentation on the same at your discretion. Your positive and objective response will help achieve the objectives of the study.

The information provided will be treated with strict confidentiality. However, the research paper may be shared to enhance NDMA activities. Your response and cooperation in this matter will be highly appreciated.

Thank you in advance,

Yours Faithfully,

Mathew Tuitoek

Appendix II: Questionnaire

SURVEY QUESTIONNAIRE ABOUT DROUGHT EARLY WARNING SYSTEM

This aim of this Questionnaire is to collect information on Effects of Drought Early Warning System in drought mitigation and management in ASALs in Kenya.

Please answer the questions freely. The information is required for academic purposes only and will be treated as confidential.

Do not indicate your name as the information given is confidential.

PRELIMINARY QUESTION

Have you ever used the Drought Early Warning System? (Select suitable answer using a tick [√])

[☐] Yes [☐] No

(If Yes, proceed to answer the questions below.

If No, do not proceed. Thank you for your time.

<u>PART ONE</u>

DEMOGRAPHIC INFORMATION

Please provide information about yourself

1. What is your age? (Select suitable answer using a tick [√])

a) Below 29 [☐]
b) 30 -39 [☐]
c) 40 -49 [☐]
d) 50 and above [☐]

2. What is your gender? (Select suitable answer using a tick [√])

a) Male [☐]

b) Female [☐]

3. Which ASAL County are you coordinating or representing?

a) Name of County: Choose an item.

PART TWO

1. Which Government Ministry, Department, Agency or County do you work/represent?

a) NDMA (County Drought Coordinator) [☐]

b) NDMA (County Drought Information Officer) [☐]

c) NDMA (County Data Analyst) [☐]

d) CSG (Select from list) Choose an item.

2. For how long have you used the Drought Early Warning System (DEWS)?

a) Never used [☐]

b) 1 to 2 years [☐]

c) 3 to 4 years [☐]

d) 5 years and above [☐]

3. What are the mediums used at your County to disseminate DEW Information?

a) CSG [☐]

b) Community Barazas [☐]

c) WhatApp groups [☐]

d) Community Barazas [☐]

e) SMS Alerts [☐]

PART THREE

DROUGHT EARLY WARNING SYSTEM

The sections below require you to indicate to what extent you agree or disagree with the statements asking about the overall use of the system, based on your experience.

Please select the number that best describes your opinion

(1 –Strongly disagree, 2 –*Disagree, 3* –Neutral, 4 –*Agree, 5* –Strongly Agree)

1. INFORMATION QUALITY

a) DEW System provides accurate information___ Click here to enter text.
b) DEW System provides relevant information___ Click here to enter text.
c) DEW System provides up to date information___ Click here to enter text.

2. SYSTEM QUALITY

a) DEW System is user friendly___ Click here to enter text.
b) DEW System is easy to use___ Click here to enter text.
c) Is the DEW System stable___ Click here to enter text.

3. SERVICE QUALITY

a) DEW System is available all the time___ Click here to enter text.
b) DEW System is always responsive ___ Click here to enter text.
c) DEW System is reliable always___ Click here to enter text.

4. DROUGHT CONTINGENCY PLANNING

a) DEW System has enhanced provision of relevant information that will improve decision making during preparation of drought contingency plans ___ Click here to enter text.
b) DEW System has enable provision of accurate information essential for early warning ___ Click here to enter text.
c) Provision of up to date Information through the DEW System has enabled timely identification of drought risks ___ Click here to enter text.

5. **DROUGHT MITIGATION STRATEGIES**

a) DEW System user friendliness has brought about efficiency and timely planning of drought contingency plans ___ Click here to enter text.

b) DEW System ease of use has ensured usability and thus enhanced capacity building for all stakeholders ___ Click here to enter text.

c) The stability of DEW System has ensured on time response to drought risk mitigation efforts ___ Click here to enter text.

6. **DROUGHT RISK MANAGEMENT**

a) The availability of DEW System has ensured timely planning of drought contingency plans ___ Click here to enter text.

b) The Responsiveness of DEW System has enhanced dissemination of early warning bulletins ___ Click here to enter text.

c) The reliability of DEW System has ensured rapid response to drought risk mitigation efforts ___ Click here to enter text.

SUGGESTIONS FOR IMPROVEMENT OF DEWS

Kindly list suggestions to improve DEWS

Click here to enter text.

Appendix III: Project Schedule

	Msc IT Management Project Schedule													
	Title: Effect Of Drought Early Warning System (Dews) In Drought Mitigation And Management In Arid And Semi-Arid Lands (ASALs) In Kenya													
	Supervisor: Dr. Agnes Wausi													
		2017						**2018**						
	Date/Month	**July**	**August**	**Sept**	**Oct**	**Nov**	**Dec**	**Jan**	**Feb**	**March**	**April**	**May**	**June**	**July**
	Activity													
1	Consultation and picking of Project Title													
2	Preparing the Proposal													
3	Milestone One Presentation													
4	Working Towards Milestone Two													
5	Milestone Two Presentation													
6	Working Towards Milestone Three													
7	Milestone Three Presentation													
8	Working Towards Publishing a Paper													

Activity	Date
1	3/7/2017
2	4/7/17 to 13/10/17
3	13/10/2017
4	13/10/17 to 13/03/18
5	6/6/2018
6	6/6/2018 to 13/06/18
7	06/06/18 to 30/07/2018