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Effects of Integration of GIS, Community Coping Strategies, and Local Knowledge in Flood Management in Narok Town, Kenya

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ABSTRACT

Flooding is one of the natural hazards that is catastrophic in nature and affects human settlements, infrastructure and livelihoods. Despite early warnings, public education and awareness as well as campaigns by the government, media and non-governmental organizations, residents of the flood prone areas are still at increased risk of death, loss of property and displacement leading to loss of livelihoods and disease. The objective of the study was to assess the effects of integration of Geographic information System, community coping strategies, and local knowledge in flood management in Narok Town, Kenya. This study adapted analytic cross-sectional study design and exploratory approach. The study population comprised of households within Narok Town. Sampling unit was a single household while the household head was the unit of analysis. Stratified random sampling technique was used to select 385 households from the different zones in the town. A structured flood coping mechanism questionnaire was used to collect data from the household head while Key informant interview guide and focus group discussion was used to gather qualitative information. Descriptive statistics included the mean, standard deviation, percentages, chi-square test were used to analyze data. Analysis was done using SPSS version 24.0 and Quantum Geographic information System to generate data and information on community coping mechanisms, geo– spatial patterns of floods and perception about floods in Narok town. Qualitative analysis was analyzed through the use of secondary literature while quantitative data was analyzed through the inferential statistics Fisher's exact test, Analysis of variance, correlation, and logistic regression. The study findings showed that there is low integration of household knowledge, coping strategies and Geographic information System in flood management among residents of Narok Town. The study further showed that lack of household knowledge was a result of lack of inadequate forecast information (41.0%), lack of public awareness 42.3% and participation. Results indicate majority of the local community did not have access to Geographic information System information in regards to flood hotspots only (30.1%) had data related to flooding, flood zones and marked physical features showing areas prone to floods disasters.

1. Introduction

Flood disaster is a worldwide natural occurrence that has negative consequences for any country, posing a risk to people's lives, destroying the environment, and impeding economic progress. Floods, which occur from time to time in rivers and natural drainage systems and often result in disastrous losses, afflict many countries around the world. As a result, flood is an unavoidable natural occurrence that results in the loss of life, property destruction, and environmental degradation, as well as significant economic loss and deterioration of population health (Lorig et al., 2014).

According to the Kenya Red Cross Society, 186 people died in Kenya as a result of heavy rainfall and flooding in 2018, with an estimated 800,000 people affected (KRCS, 2018). This includes an estimated 300,000 individuals who have been displaced, as well as 100 persons who have been injured. Garissa, Isiolo, Kisumu, Mandera, Marsabit, Samburu, Taita-Taveta, Tana River, Turkana, Wajir, and West-Pokot were among the counties most impacted by flooding in 2018, according to the National Disaster Operational Centre. The counties of Mandera and Tana River have the greatest rates of displacement. However, the KRCS noted that continuous rains had increased humanitarian needs in counties in the central and western provinces. According to the United Nations Office for Humanitarian Affairs, an estimated 35,000 people were affected in counties in western Kenya, with some households still living in displacement camps (UN-OCHA, 2018).

GIS is a valuable system for flood control because it is designed to acquire, store, manipulate, analyze, manage, and present various forms of spatial or geographical data. Users can construct interactive queries using GIS application tools (Ahmed, 2021). According to the National Climate Change

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Response Strategy, substantial populations in Kenya have access to various technologies such as computers, which can be utilized to provide a plethora of information for assessment, data acquisition, and analysis of catastrophes such as floods (GoK, 2018).

Narok County has been plagued by severe flooding for the previous two decades, according to World Bank 2020, with people losing their lives and others being relocated. The floods have affected three of the five constituencies, namely Narok North, Narok South, Trans Mara East, and Trans Mara West. Furthermore, excessive rains in Narok County cause extensive infrastructural damage, notably to roads and bridges. As a result, the study's major goal was to discover how the local community's indigenous coping strategies may be merged with Geographic Information Systems (GIS) to improve flood management in Narok Town.

Kenya is vulnerable to natural disasters like floods, which are expected to become more common as a result of climate change. According to the Vision 2030 Second Medium Term Plan, 2013-2017, disaster management is a cross-cutting issue that necessitates joint action by public and private sector agencies at the national, county, and community levels (GoK, 2013). Flooding in Narok Town is a chronic problem that has a negative influence on people's lives in the affected areas, with flooding affecting more than 56 percent of the local population during the rainy season (Toufique and Islam, 2014). The general flooding tendency in Narok Town is characterized by the expanding population in and around these low-land plains, as well as the destruction and invasion of the Mau forest (Ombogo, 2016).

In recent years, the Kenyan government has put in place a comprehensive legislative and strategic framework for disaster risk management. Since the 2010 Constitution recognized the state's responsibility to protect vulnerable populations, it has allowed for the declaration of a state of emergency in the event of hazardous conditions such as fires, floods, and droughts. The (GOK, 2009) Draft National Disaster Management Policy (2009), the National Disaster Response Plan (2009), the County Governments Act (2012), the National Emergency and Disaster Response Plan and SOPs, and the 2016 Water Act are among the most relevant policies and programs.The National Disaster Risk Management Bill 2019 and the Disaster Risk Financing Strategy 2018, both of which emphasize the importance of better disaster prevention, preparedness, mitigation, response, and recovery, particularly in relation to floods, have laid the legislative groundwork for flood risk management (GoK, 2018).

Kenya's government has stressed the importance of more comprehensive catastrophe risk funding. This is especially true for drought risk, while funding instruments for other types of hazards are also taken into account. The Disaster Risk Financing Strategy 2018 emphasizes the necessity of organized financial methods for more effective disaster prevention, preparedness, mitigation, response, and recovery, thus paving the way for early action financing. The strategy proposes the establishment of a Disaster Risk Management Fund to combine and harmonize new and existing sources of disaster risk financing at the national level in order to promote structured finance. It also suggests that under the direction of the Treasury, ministries allocate cash for disaster risk management, and that county governments make appropriate supplementary contributions. However, the legislative framework for regulating and administering finances and donations associated with the program is still being debated in the Senate as part of the National Disaster Risk Management Bill (GoK, 2017).

Flood disasters in Narok town have been identified by the County government as a key problem that cut off roads and settlements, kill people, and destroy property every year (GOKb, 2018). Recurrent floods in the town present one of the most challenging regional and national hazards. Floods have resulted in the loss of property, as well as the death of cattle and the destruction of nearly 200 acres of food crops (Ombogo, 2016).

2. Research methodology

2.1 Research design

In order to meet the study's objective, the researchers used an analytic cross-sectional study design that included qualitative and quantitative data collection approaches. This approach is appropriate for the study's nature because it incorporates analytics and necessitates the description, recording, analyzing, and interpreting of existing conditions. It also entails various comparisons and contrasts in order to uncover relationships (Cooper and Schindler, 2011).

2.2 Study area

The research was carried out at Narok town, which is the administrative center of Narok County in Kenya's south west. It is bordered on the north by Nakuru County, on the east by Kajiado County, on the south by Republic of Tanzania, and on the west by Bomet and Migori. Narok is located between latitudes 1°0'0" 'S and 2°0'0" 'S, and longitudes 35°0'0" East and 37°0'0" East, with an elevation ranging from 1827 to 2138 meters above sea level. Narok is a town with a total area of 215.4 km2 (KNBS, 2019) Figure 2.1.

2.3 Sample Size and Sampling Techniques

To determine the number of households' heads, Fischer's formula was used based on simple random sampling.

$$n = \frac{Z^2 pqN}{e^2(N-1) + Z^2 pq} \quad \text{……………………Eq. 2.1}$$

Where

n denotes the sample size and N denotes the whole population.

Z= the z score corresponding to a significance level of =0.05,

E stands for Expected Error.

p = interest probability,

q denotes the likelihood of non-interest.

However, because N is a large number, 11,776 households, the formula reduce the to;

n = $(\boldsymbol{Z^2 * p * q}) \div \boldsymbol{e^2}$

Which normal approximation to binomial where

P=0.5, q=0.5, Z0.025=1.96, e=0.05,and substituting these values in the formula3.2, the sample size result is,

Sample size

385 = n = (1.962*0.5*0.5)/0.052 household heads.

As a result, 385 households were sampled for the study in order to obtain the necessary primary data. Narok was purposefully chosen because of its continued vulnerability and the high magnitude of recurrent floods. Key informants were purposively selected which include Sub–County disaster management committee members, stakeholders involved in emergency services (Kenya Red Cross), Kenya Meteorological department and community elected leaders because they had in depth understanding of the research variables.

This study used Stratified Random Sampling. The numbers of households were identified per stratum based on the perpendicular distance of Household location from the river. The first zone is 0-100 meters from, second isfor Households within 100-150 Meters and finally above 150 meters from the river formed the three zones because they are at different risk profiles-high risk, moderate risk and low risks respectively. As shown in Table 2.1, the sample of 385 household heads was proportionately divided among the three categories.

Because of the variation in the number of household units in the risk areas, a stratified-sampling strategy was used to determine the number of household units that were sampled per risk area in order to obtain proportions (Barreiro and Albandoz, 2001).

$$nh = \left(Nh/N \right) n \quad \text{…………………………..} \quad \textbf{Eq. 2.2}$$

nh = sample size of stratum

Nh = Population size of the stratum

N = Total population size

n = Total sample size

In this study, samples of 133, 131 and 121 household heads were sampled from the three strata.In addition, one (1) member of the Sub-County disaster management committee, one (1) emergency service officer, and six (6) community leaders were purposefully chosen for the study.

The researcher assisted by the research assistants conducted mapping to identify all the target population mainly households within the three zones from the river. A Sampling frame was then generated after the mapping, which contained all the households within the study area. The study included every fifth household until all 385 respondents were located and their contact information was submitted to the research assistants.

To investigate the effect of household knowledge on flood control, the researchers used linear regression analysis. According to the model summary in Table 3.1, local knowledge accounted for 23.6 percent of the variation in flood management across Narok Town households. As a result, homes with sufficient knowledge were more effective in flood management than those with insufficient information.

F-statistics =118.474 (p=0.000) suggest that the regression model developed had a strong fit, according to the ANOVA findings. As a result, this model predicts how household knowledge affects flood management in Narok Town.

According to a UN research published in 2018, at least 2.5 billion people have been affected by floods in the last ten years, up 60% from the preceding decade. Between 2008 and 2018, calamities such as floods and hurricanes killed around 478,000 people. Those who live in undeveloped countries are the most vulnerable. Asia and Africa have been the most severely affected continents, accounting for more than half of the deaths and over 90% of the individuals afflicted over the last decade. Around 44% of the global flood disasters that occurred between 2008 and 2018 impacted poor countries.

Floods account for around 40% of natural disasters, according to the OECD (2020), and may become more frequent and severe as a result of global warming. Many research surveys on floods and their effects have been undertaken, encompassing social, economic, and health impacts and management. Following significant river flooding in Southern England, an assessment of the effects of flooding on flood victims' health was done in the town of Lewes.

Household knowledge had a coefficient of 0.252 and a p-value of 0.000, according to the results in Table 3.3. These findings suggest that flood management was influenced by

Table 2.1. Proportional Allocation by risk areas.

Stratum	Total Number of Households (Nh)	Sample size $nh = \left(Nh/N \right) n$
Within 100 meters (High Risk)	4077	133
100-150 meters (Moderate risk)	3990	131
Over 150 meters (Low Risk)	3709	121
Total	11776	385

Source: GoK, 2019 and Researcher (2021)

Table 2.2. Summary of study population units, sample methods and sample size.

Population Units	Sample size	Sampling strategy
Households	385	Stratified
County Disaster committee member	1	Purposive
Emergency Service providers	1	Purposive
Community leaders	6	Purposive
Focus Group Discussions	3	Quota Sampling

Source: Researcher (2021)

Table 3. 1. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.486[a]	.236	.234	.34448

a. Predictors: (Constant), Household Knowledge

b. Table 3. 2 ANOVA

	Sum of Squares	df	Mean Square	F	Sig.
Regression	14.059	1	14.059	118.474	.000b
Residual	45.448	383	0.119		
Total	59.506	384			

a Dependent Variable: Flood Management At HH

b Predictors: (Constant), Household Knowledge

Table 3. 3 Regression Coefficients

	B	Std. Error	Beta	t	Sig.
9(Constant	2.446	0.048		51.159	0.000
Knowledge	0.252	0.023	0.486	10.885	0.000

a Dependent Variable: Flood Management At HH household knowledge. Increased household awareness would result in better flood management in Narok Town.

These findings corroborate those of a Key Informant interview and a focus group discussion, which found that having access to information led to early flood preparedness and efficacy. However, the majority of individuals polled stated that indigenous knowledge was mostly used to anticipate floods. The study backs up Zwgliski (2020), who states that the Sustainable Development Goal 11, "making cities and human settlements safe, resilient, and sustainable," is heavily focused on disaster management systems, such as disaster response.

The study discovered that people living in close proximity to nature accumulate a body of knowledge through observation and hands-on experience, which is then passed down by oral tradition from generation to generation. Indigenous coping methods are an integral aspect of indigenous wisdom.

3.2 The effect of community coping strategies on flood management

In this section, the study analyzed the effect of various communities coping mechanism on flood management. The results of the model summary presented in Table 3.4 show that community coping mechanism accounted for 6.7% of the flood management in Narok town. The findings implied that households in Narok town lacked effective coping mechanism to address the floods in the area.

Table 3.4 Model Summary

Model	**1**
R	.286a
R Square	0.082
Adjusted R Square	0.067
Std. Error of the Estimate	0.38017

F-statistics = 5.622 and p = 0.000 revealed that the regression model used to investigate the effect of community coping mechanisms on flood management had an excellent fit. The findings revealed that local communities' flood control measures in Narok Town were significantly predicted by community coping mechanisms. The floods can be better managed at household level when the communities are able to have sustained coping mechanisms. Preventive and reactive strategies are critical in achieving sustainable flood management.

Terraces increase temporary surface moisture storage capacity and encourage infiltration, according to Ruto *et al*., (2016), and this study demonstrates the large influence that land use, slope, and precipitation can have on soil moisture distribution, with higher moisture recorded at the lower slope position and lower moisture recorded at the upper slope position. Terraces alter the spatiotemporal distribution of soil moisture and must be taken into account when analyzing hydrological soil attributes. They are management measures that residents in the area can use to increase flooding efficiency.

According to the OECD (2020), a telephone interview was used to conduct a historical study for new episodes of disease in all age categories, as well as psychological distress in adults. A random selection of addresses from a post-flooding survey and a commercial database were used to interview 227 residents of 103 flooded households and 240 residents of 104 non-flooded households in the same postal district.

The study's findings revealed that the link between flooding and new episodes of physical illness in adults was reduced after psychological distress was taken into account (Armenta *et al*., 2018). According to the findings of the study, the link between physical ailments and guidance and support with personal, household, and environmental hygiene, as well as access to medical services, is critical.

Table 3.6 shows that the coping mechanism has an unstandardized regression coefficient of B=.0690 (p=.001), which is statistically insignificant at 0.05. As a result, Coping Mechanisms appear to have a considerable positive impact on flood control.

The findings support those of Dankers and Kundzewicz (2020), who argued that one of the components of holistic flood management is pre-flood preparedness, which includes decisions for future planning that may result in long-term environmental changes. Local populations in Kenya and around the world, according to the author, are increasingly suffering the brunt of flood-related challenges.

Plate 3.1 Plate Effects of floods.

Floods are observed to be destroying property in Narok Town. For instance, the vehicle that is above was observed to have been swept away. The water that is flowing is observed to be inches high. Nevertheless, it has detrimental effects to the people that don't know the force which it has despite being less than three to five inches. Fast-moving water, according to Taylor (2017), is extremely dangerous — water moving at 10 miles per hour can exert the same pressures as wind gusts of 270 miles per hour (434 kilometers per hour).

Human activities and emergency actions before, during, and after a flood disaster, according to Francesch-Huidobro *et al*. (2017), have the capacity to lessen the likelihood of flooding as well as change the spatial features of a flood

Table 3. 5 ANOVA

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	4.875	1	0.812	5.622	.000b
Residual	54.632	383	0.145		
Total	59.506	384			

a Dependent Variable: Flood management at HH

Table 3.6 Regression Coefficients.

	B	**Std. Error**	**Beta**	**t**	**Sig.**
(Constant)	3.347	0.173		19.295	0.000
Coping mechanisms	.069	.020	.177	3.510	.001

a Dependent Variable: Flood Management

by altering flood routes. According to Kabingue, *et al*. (2014), flood control plans should include boosting community knowledge of flood impacts, enhancing public participation in flood management, and stringent solid waste management.

During the FGD, a participant mentioned that:

"some of the floods coping mechanism used by the local communities in Narok Town before the flooding included, moving of property and people to more safer places, digging of terraces around their premises, sensitization of people on the impeding flooding, unclogging of drainage systems and relocation of livestock" (Field Data, 2020).

During flooding, key informants mentioned that local communities coped through moving to higher grounds, conducting rescues mission, offering shelter and food to affected families among others. The coping mechanisms mentioned after the floods included reconstruction/ rehabilitation of damaged river dykes, clearing of debris and rehabilitation of damaged areas, assessing the damaged property, seeking assistance from government agencies among others.

This finding is consistent with a research by Nyakundi *et al*. (2010), which found that impacted families in flood-prone areas typically leave their homes and relocate to camps or the homes of friends and relatives. The main flood-prevention strategies used by residents in flood-prone communities included clearing blocked gutters, creating flood steps, elevating ground before building, and putting valuables on shelves.

3.3 Effect of integration of GIS in flood management

The results of the regression analysis performed to examine the influence of GIS integration on flood management in Narok town are presented in this section. The results of model summary show that GIS integration alone accounted for 17% of the flood management strategies by household in Narok Town other factors held constant. The finding implied that integration of GIS had a large explanatory power on flood management in Narok Town.

Table 3.7 Model Summary

Model	1
R	.413a
R Square	0.17
Adjusted R Square	0.168
Std. Error of the Estimate	0.35903

The regression model used had a good fitness as shown by F=78.638 (p=0.000). The findings of ANOVA imply that GIS integration could significantly predict flood management among households in Narok Town.

According to Dogulu *et al*., (2015), flood risk professionals must have a certain level of knowledge and insight into these subjects. Considering also the dynamic and dependent nature of a flood risk system, the practice of FRM is inevitably challenging in multiple ways. Hence, flood risk managers and professionals are often faced with difficulties.

In this regard, developing training and education programs is crucial not only for improving the present knowledge and abilities of existing flood risk professionals, but also for increasing capacity through educating future flood risk experts. Unfortunately, the value of such training and education has not been adequately recognized at both the undergraduate and graduate levels. Incorporating a consistent comprehensive and integrated strategy to FRM teaching is still needed over the world.

Table 3.8 ANOVA

	Sum of Squares	**df**	**Mean Square**	**F**	**Sig.**
Regression	10.137	1	10.137	78.638	**.000b**
Residual	49.37	383	0.129		
Total	59.506	384			

a Dependent Variable: Flood Management At HH
b.Predictors: (Constant), GIS Adoption

According Biswas *et al*. (2017), to Disaster is a consequence of inappropriate risk management including both hazards and vulnerabilities. In developing countries, about 95 percent of all deaths are caused by disaster hazards, 20-times greater than in industrialized countries. With respect to disaster risk, Bangladesh is one of the most vulnerable countries in the world, and many people have died or become disabled due to disasters with water-related natural and manmade disasters most commonly encountered.

Table 3. 9 Regression Coefficients.

	β	**Std. Error**	**Beta**	**T**	**Sig.**
(Constant)	2.572	0.044		57.982	0.000
GIS Integration	0.323	0.036	0.413	8.868	0.000

a Dependent Variable: Flood Management At HH

The results in Table 3.9 show that GIS integration has a coefficient of 0.323 (p=0.000) implying that GIS integration improved flood management by community in Narok Town. The finding indicated that GIS integration increased the effective of flood management in Narok Town. The study support those of Uddin *et al*. (2013), who found that flood hazard maps, delineating flood zones and identification of the potential area of shelter zone locations are important in flood management. The study further revealed that modern techniques and GIS systems allow different rules for different classes that can be analysed for further flood mapping.

These conclusions are consistent with the results of the focus groups and interviews with key informants. During the FGD, participants were negative on the application and integration of GIS in Flood management in Narok town. One of the participants mentioned that;

"Majority of the residents living in Narok town that are more prone to flooding have no idea what GIS is and how it can be applied in the management of flood" Majority of the participants agreed with this position which implied that the level of integration of GIS in flood management by local communities was very low"(Field Data, 2020).

The respondents (31.4%) interviewed disagreed on whether they had access to GIS materials delineating folds zones even though they were aware of existence of such materials in government and other development partners such as Red Cross.

Drowning is one of the main causes of death worldwide, according to Biswas *et al*. (2017), with children and people from underdeveloped nations being the most common casualties. Drowning is one of the top causes of death in Bangladeshi children aged 1-4 and 5-9 years. Drowning is responsible for 11.7 percent of injury fatalities in Bangladesh, according to a 2016 health and injury survey. In 2016, a health advisory stated that drowning is Bangladesh's greatest cause of death. Flood management encompasses a wide range of water resource activities aimed at lowering the risk for floods to affect people, the environment, and the economy in the region. The existing flood management approaches have a major flaw in that they prioritize economic impacts while paying little attention to flood's environmental and social consequences.

3.4 Multivariate Regression Model Results

This section summarizes the findings of a multivariate regression study conducted in Narok Town to determine the combined influence of GIS integration, coping techniques, and local knowledge on flood management. The findings of the model summary in Table 3.10 demonstrate that flood management in Narok town was 27.0 percent (R-square = 0.270) due to the integration of GIS, coping measures, and local knowledge. The findings suggest that flood management in Narok Town was aided by the integration of GIS, coping mechanisms, and local knowledge.

The findings also support Madi, *et al*. (2020), who stated that the comprehensive modelling approach employed in the study is effective in locating flood-prone areas and estimating inundation depths at a given discharge value.

Table 3.10 Model Summary.

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.519[a]	.270	.264	.29063

a. Predictors: (Constant), GIS Integration, Integration of coping strategies, Local Knowledge integration

The analysis of variance of the model used to investigate the effect of integrating GIS, coping techniques, and local knowledge in flood management is shown in Table 5.11. Since the model showed a goodness of fit (f=46.858, p=0.0000.05), the study further suggests that integrating GIS, coping techniques, and local knowledge in flood managements strongly predicted flood management in Narok town.

According Ahmed (2021), Geographic information systems: integrative systems that combine programs, devices, and qualified human competence, information and analytical methods to study spatial information – in its descriptive and geographic parts – associated with geodetic or global coordinates known in the globe's axes systems, and then monitor, store, recall, process, model, analyze, update, display, and distribute. It would be the best platform to lead to the development of spatial awareness in Narok, town.

The regression coefficients used to estimate the influence of integrating GIS, coping techniques, and local knowledge in flood management are shown in Table 3.11. Coefficients of Regression Local knowledge integration had a coefficient of =0.184, p=0.0000.05, according to the findings. These findings suggest that incorporating local knowledge into flood management has a favorable and significant impact. The findings also suggested that using local knowledge benefited the communities' flood management techniques in Narok Town.

These findings are consistent with those of Elrick-Barr *et al*. (2015), who found that any town can go beyond the minimal program requirements by enacting more stringent regulations. Professionals working in flood risk management must have a specific level of expertise and understanding of these topics. Given the dynamic and interdependent character of a flood risk system, FRM is inherently difficult in a variety of ways.The Hyogo Framework for Action on disaster management and reduction. Creating awareness and conveying of flood information enhances preparedness through appreciating the local knowledge and integrating contemporary sources of information and their means of conveying them.

GIS integration showed a coefficient of =0.095, p=0.0000.05, according to the findings. These findings suggest that integrating GIS technologies into flood management has a favourable and significant impact. The findings back up those of Uddin *et al*. (2013), who discovered that flood danger maps, flood zone delineation, and identification of suitable shelter zone locations are all essential in flood management. The study also demonstrated that contemporary methodologies and GIS systems enable distinct rules for different classes to be analyzed for flood mapping purposes.

The results of multivariate regression presented in Table 3.12 further show that coping strategies integration had a coefficient of β=0.060, p=0.106>0.05. These finding indicate that integration of coping strategies had a positive but insignificant effect on flood management in Narok Town in Kenya. The findings match those of Kundzewicz (2020), who stated that one of the components of comprehensive flood management is pre-flood preparedness, which includes decisions for future planning that may result in long-term environmental changes. Local populations in Kenya and around the world, according to the author, are increasingly suffering the brunt of flood-related challenges.

F-statistics =118.474 (p=0.000) revealed that the regression model fitted in the study had an excellent fit. As a result, the effect of household knowledge on flood control by households in Narok Town is predicted by this model. The coefficient of household knowledge was 0.252, with a p-value of 0.000. These findings suggest that flood management was influenced by household knowledge. However, the majority of individuals polled stated that indigenous knowledge was mostly used to anticipate floods.

Table 3.11. ANOVA

ANOVA a	Sum of Squares	df	Mean Square	F	Sig.
Regression	11.874	3	3.958	46.858	**.000b**
Residual	32.182	381	0.084		
Total	44.056	384			

a Dependent Variable: Flood Management

b Predictors: (Constant), GIS Integration, Integration of coping strategies, Local Knowledge

Coefficients	B	Std. Error	Beta	t	Sig.
Constant	2.94	0.136		21.552	0.000
Local Knowledge Integration	0.184	0.022	0.405	8.305	0.000
Integration of coping strategies	0.060	0.037	0.071	1.62	0.106
GIS Integration	0.095	0.026	0.18	3.683	0.000

a Dependent Variable: Flood Management

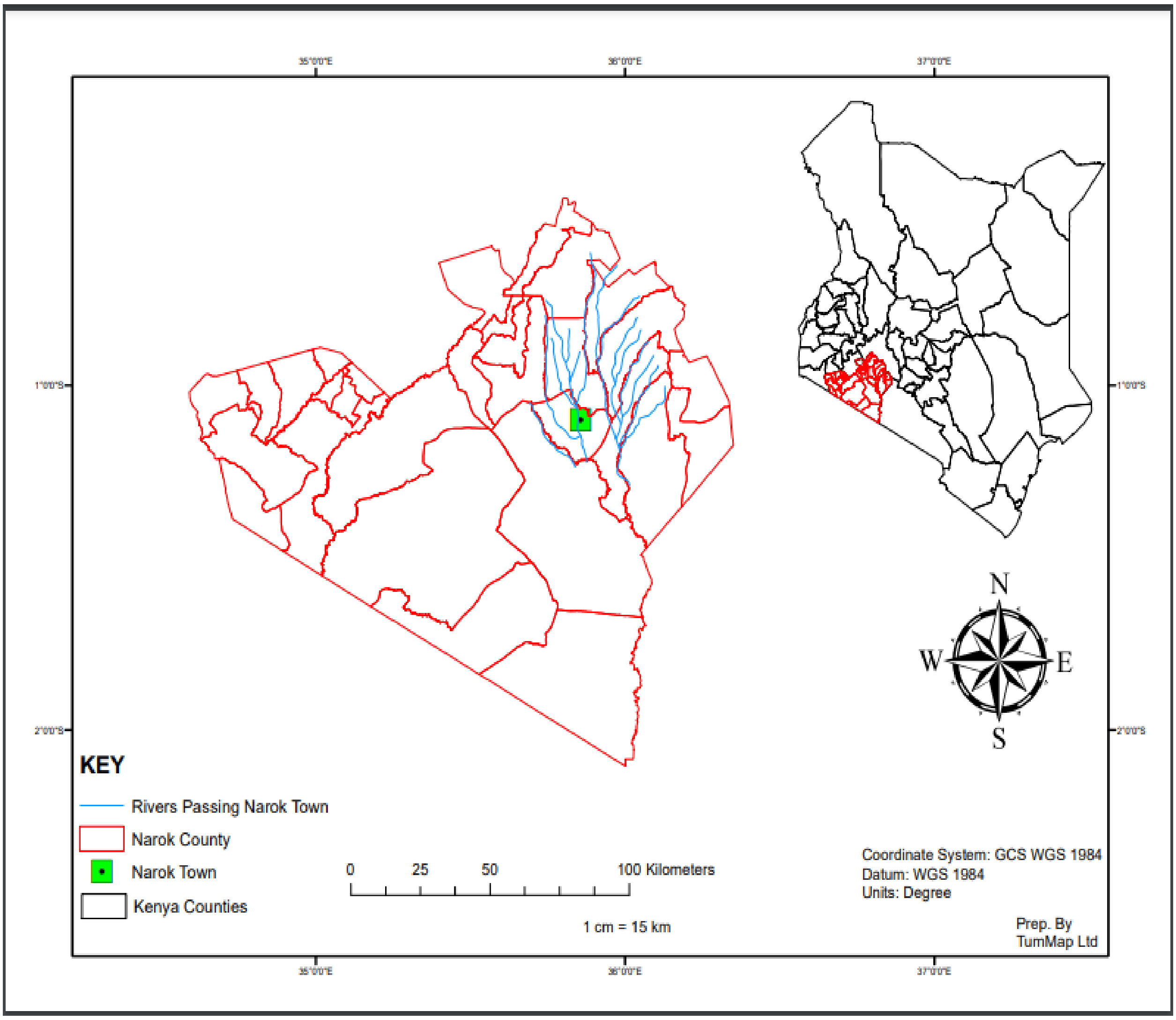

Figure 2.1. Map of study area

Source: Researcher (2021)

4. Conclusion

The study concluded that integration of modern technologies such as GIS has been used successfully in flood management and helping local community in their coping mechanism. However, this study showed that Narok town even though there has been effort to map flood hotspots, such maps and relevant information has not been availed to majority of the households in flood prone areas. The community lack access to geo spatial information on floods occurrence in Narok Town which hinders then from coming up with the necessary coping mechanisms.

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