

The **KENYA INSTITUTE** for **PUBLIC**
POLICY RESEARCH and **ANALYSIS**

Households Coping Mechanisms and Resilience to the Impacts of Droughts and Floods in Kenya

Adan Guyo Shibia

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Adan Guyo Shibia

Kenya Institute for Public Policy
Research and Analysis

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KIPPRA in Brief

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Abstract

The frequency and severity of droughts and floods hazards are projected to increase with climate change. Households are affected through various mechanisms including income and asset losses that translate to other undesirable socio-economic outcomes such as poor health, reduced human capital development and increased poverty. These socio-economic impacts pose threats to the realisation of development goals including those anchored in the Kenya Vision 2030, the Big Four Agenda of the Kenyan government and the Sustainable Development Goals (SDGs) commitments. Insights on how households cope with and build resilience to the impacts of droughts and floods are important policy imperatives. While there is a range of coping mechanisms that includes informal measures such as dependence on social networks and market-based measures such as the use of formal financial instruments, the former is generally shown to be less effective due to covariate and recurrent nature of climate change induced hazards. Despite such limitations, there are concerns Kenyan households largely depend on non-market informal coping mechanisms, which if left unaddressed will likely result to significant socio-economic costs. The aims of this study were to draw lessons from review of selected interventions and establish how households cope with the impacts of droughts and floods, focusing on various typology including finance coping mechanisms and non-finance coping mechanisms that are further disaggregated into formal and informal coping measures. The study also aimed at establishing factors that support household resilience to the impacts of droughts and floods, focusing on the roles of finance and non-finance coping mechanisms and access to climate information.

In achieving the intended objectives, the study employed review of institutional framework related to the subject, review of literature to draw lessons from existing interventions and analyses of secondary and primary household survey data. Descriptive analyses of a national-wide cross-sectional secondary data of the 2015/2016 Kenya Integrated Household Budget Survey (KIHBS) and in-depth descriptive and econometric analyses of a cross-sectional primary household survey data collected by the Kenya Institute for Public Policy Research and Analysis (KIPPRA) in early 2018, covering 27 Kenyan counties that are prone to droughts and floods were used to provide deeper insights. Bivariate Probit and univariate Probit regressions were used to analyse factors determining coping mechanisms and household resilience, respectively.

The review of institutional framework shows existence of multiple institutions and policies aimed at climate change adaptations and building resilience to the impacts of climate-induced risks. The existence of multiple institutions calls for effective coordination to leverage on synergy. Further, linking customary/

traditional coping institutions with formal institutional arrangements seems to have positive results. Review of existing interventions reveal designing and deepening of market-based coping mechanisms require partnerships among the financial institutions, research institutions, development partners and the government. The analyses of the secondary and primary survey data suggest households use multiple coping mechanisms including finance and non-finance coping measures. Use of market-based coping mechanisms, especially financial instruments such as credit and insurance are found to be low. Key challenges hindering use of financial instruments are found to include low and variable household incomes; financial illiteracy; high costs of credit and insurance premiums; and slow response of financial institutions to adapt products to the dynamics of droughts and floods. Urban households and non-ASAL households tend to relatively use formal coping mechanisms while rural and ASAL households tend to rely on informal coping mechanisms. The regression results show that the use of finance and non-finance coping mechanisms tend to be complementary; while use of formal finance and informal finance coping mechanisms tend to be substitutes. The findings also suggest that access to climate information through modern media tend to foster household resilience. Additionally, household resilience is affected by various factors including socio-economic characteristics, geographic and agro-climatic factors. Urban households, higher household income and use of formal savings seems to improve household resilience. The main conclusions from this study are that building household coping mechanisms and resilience in mitigating the impacts of climate change induced risks need to be part of the larger private sector development including market development, technology development, access to climate information systems and effective coordination framework. Deepening household use of financial instruments for coping with droughts and floods call for overcoming demand and supply barriers.

This study provides impetus for future empirical work and related initiatives that can provide further policy insights. Key considerations for future work include building longitudinal data on household coping mechanisms and resilience, deeper insights on constraints to use of finance coping mechanisms and use of composite indicators for household resilience.

Abbreviations and Acronyms

| | |
|-----------|--|
| ASALs | Arid and Semi-Arid Lands |
| CBK | Central Bank of Kenya |
| FSD Kenya | Financial Sector Deepening Kenya |
| GDP | Gross Domestic Product |
| GoK | Government of Kenya |
| HSNP | Hunger Safety Net Programme |
| IBLI | Index Based Livestock Insurance |
| ILRI | International Livestock Research Institute |
| IPCC | Intergovernmental Panel on Climate Change |
| IRA | Insurance Regulatory Authority |
| KIPPRA | Kenya Institute for Public Policy Research and Analysis |
| KIHBS | Kenya Integrated Household Budget Survey |
| KNBS | Kenya National Bureau of Statistics |
| NDMA | National Drought Management Authority |
| SASRA | SACCO Societies Regulatory Authority |
| UN/ISDR | United Nations Interagency Strategy for Disaster Reduction |
| UNFCCC | United Nations Framework Convention on Climate Change |

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1. Introduction

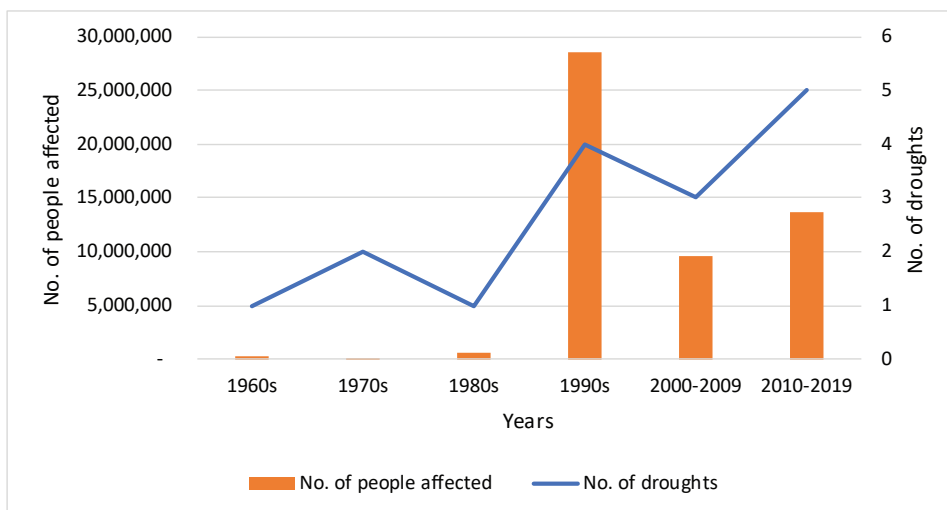
1.1 Background

The impacts of climate change are unequivocal as evident from warming of the atmosphere and oceans and rise in sea levels, which are predicted to increase over the next decades (IPCC, 2013). With these climatic changes, frequencies and severity of droughts and floods have been on the rise. Droughts and floods adversely impact households through various channels including income volatility, loss of lives, health deterioration and welfare losses resulting from depletion of capital and savings (Castells-Quintana, Lopez-Uribe, & McDermott, 2018). Within the Sub-Saharan Africa (SSA) region drought and floods account for 80% of loss of life and 70% of economic losses attributable to natural hazards (Bhavnani, Vordzorbe, Owuor, & Bousquet, 2008). Within the East African region, the frequency, duration, severity and the areas impacted by droughts and floods have increased significantly over the last two decades (Gebremeskel, et al., 2019). Kenya is not an exception with the 2008-2011 prolonged drought alone estimated to have resulted to US\$12 billion in damages and losses, of which about 93% resulted from disruptions in income flows across various sectors of the economy (GoK, 2013b). The 2015/2016 Kenya Integrated Household Budget Survey (KIHBS) indicates households in Kenya are adversely affected by droughts and floods through income and asset losses: 42.9% of the households suffered income losses; 13.0% suffered asset losses; and 38.8% suffered both income and asset losses (KNBS, 2018b). Given the magnitude of these socio-economic costs, this study aims at deepening insights on various measures households take to mitigate the impacts of droughts and floods in Kenya, and factors that support resilience of the households to the associated risks.

Drought is defined as a recurrent natural-climatic condition characterized by lack or inadequate precipitation over an extended period of time (Mutua & Zaki, 2010); while flood is defined as a temporary, partial or complete covering of otherwise dryland by tidal waters or inland rapid surface water runoffs (Federal Emergency Management Agency, 2018). In Kenya, like other countries in the region droughts are increasingly followed by floods (Université Catholique de Louvain (UCL) - CRED, 2019), hence making it imperative to analyse how households cope with the risks posed by both hazards. While droughts are slow-onset hazards, floods are generally sudden-onset hazards (Neef, et al., 2018). When households are impacted by droughts (which can be prolonged over several months) their capacities to cope with floods which might subsequently occur would be significantly weakened, thus worsening their vulnerabilities. Figures 1.1a and 1.1b show trends in droughts and

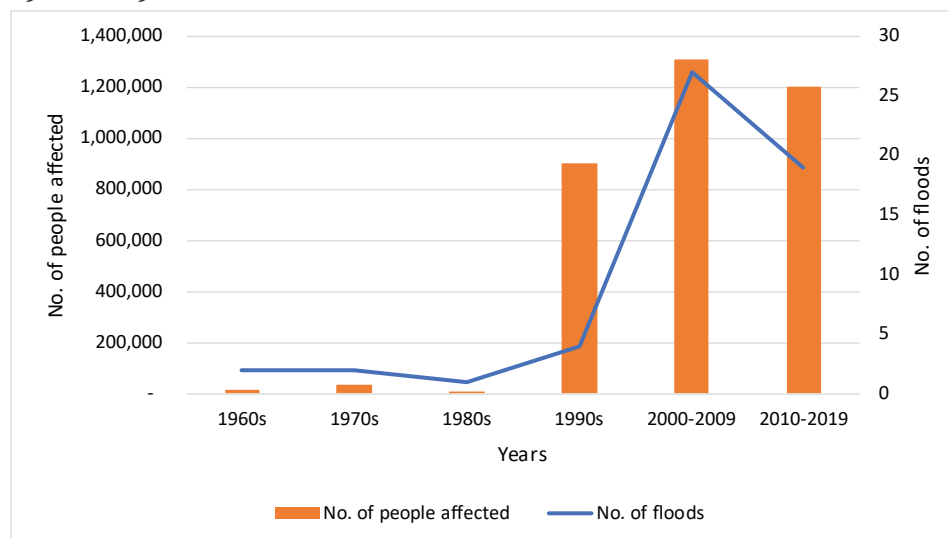
floods as well as the number of people affected (deaths, injuries or left homeless) in Kenya since 1960. The figures suggest recurrence of droughts and floods as well as the number of people affected have been on the rise. Both droughts and floods are therefore of immense interest for development policies and priorities such as the Kenya Vision 2030 and the Big Four Agenda. The realisation of development aspirations anchored in the national policies and global commitments such as Sustainable Development Goals (SDGs) can be adversely affected unless private sector agents develop coping mechanisms essential for building resilience to the impacts of droughts and floods among other climate change induced shocks. With regards to food and nutrition security prioritised by the Kenyan government in the Big Four Agenda, for instance, droughts and floods directly pose adverse impacts through disruptions of food production and supply chains. The manufacturing sector that is envisaged to drive economic growth and employment, by both the Kenya Vision 2030 and the Big Four Agenda depends to a large extent on agriculture and energy sectors as sources of inputs. Prolonged droughts and floods dampen agricultural production while cost and supply of electricity is susceptible to droughts for economies such as Kenya that partly depend on hydro sources. Households can therefore be indirectly affected when firms cut back on production or employment due to shortage or high costs of inputs.

Figure 1.1a: Trends in droughts and number of people affected in Kenya: 1960-2019



Data Source: Université Catholique de Louvain (UCL) - CRED, 2019

Figure 1.1b: Trends in floods and number of people affected in Kenya: 1960-2019



Data Source: Université Catholique de Louvain (UCL) - CRED, 2019

Kenya's unique agro-climatic and livelihood contexts make it highly vulnerable to climate induced hazards. Over 80% of Kenya's land area is Arid and Semi-Arid Lands (ASALs) supporting 36% of the population and 70% of the national livestock (Ministry of Devolution and ASAL, 2018). The agricultural sector which is disproportionately susceptible to the impacts of droughts and floods accounts for about 34% of Kenya's Gross Domestic Product (GDP) (KNBS, 2019), 65% of exports and over 60% of employment in rural areas (KNBS, 2016), implying shocks to the sector can have severe impacts on the households and the overall economy. Other sectors such as manufacturing depend on agriculture as a source of inputs and are therefore affected through value chain linkages. In recognition of these immense implications, the Second Medium Term Plan of the Kenya Vision 2030 prioritised ending drought emergencies as one of the key foundations for realisation of the country's long-term target of 10% annual growth rates in Gross Domestic Product (GDP). The policy focus has received a renewed impetus through the Third Medium Term Plan of the Kenya Vision 2030 which recognises ending drought emergencies as one of the foundations for national development (GoK, 2018a).

When faced with risks emanating from droughts and floods, households may employ among five broad coping mechanisms: Mobility, storage (e.g. water, food), diversification, communal pooling (e.g. infrastructure development and

information gathering) and market exchange measures such as use of financial instruments (Agrawal & Perrin, 2009). Not all the coping mechanisms however provide robust household resilience and sustainable adaptations, especially if they make households vulnerable in subsequent periods (Crick, Eskander, Fankhausa, & Diop, 2018a). Use of formal financial instruments including insurance and credit falls within the scope of market exchanges, which are shown to be more versatile and effective in building long-term adaptations (Agrawal & Perrin, 2009; Crick, Eskander, Fankhausa, & Diop, 2018a). Other coping mechanisms such as selling of assets or use of social networks are shown to be less effective as they are depletable and make households vulnerable due to recurrent nature of droughts and floods (Skoufias, 2003; Gao & Mills, 2018). Droughts and floods also occur on a large-scale (Agrawal & Perrin, 2009), impacting significant proportion of the households. Such covariate nature of droughts and floods means reliance on informal coping arrangements anchored on social ties is likely to be ineffective (Crick, Eskander, Fankhausa, & Diop, 2018a).

It is worth understanding the meaning of key concepts as used in this paper, including coping and adaptation mechanisms, vulnerability, hazard, risks and resilience. Adaptation mechanisms are long-term measures, aimed at mitigating impacts of both slow-onset (e.g. drought) and sudden-onset (e.g. floods) hazards, while coping mechanisms are short-term survival interventions (Neef, Bengel, Boruff, Pauli, Weber, & Varea, 2018). The short-term coping mechanisms usually provide the basis for transitioning into long-term adaptations (Agrawal & Perrin, 2009). It is therefore important to gain insights on the nature and effectiveness of coping measures household use, as they form the micro foundations for adaptations that determine long term developmental outcomes. Vulnerability refers to the predisposition or susceptibility to be adversely affected; while hazards refer to potential occurrence of events such as droughts or floods that cause damage or losses (IPCC, 2014; Watanabe, et al., 2018). Risk is a product of probability of hazard occurring and the adverse impact if it occurs, such that it is an uncertain and undesirable outcome (IPCC, 2014). Resilience entails capacity of the households to withstand risks.

Building effective household coping mechanisms to mitigate the impacts of droughts and floods require deepening of financial instruments that support pooling, transfer and diversification of risks. This is one of the development priority areas for action anchored in the United Nation's Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015c), of which Kenya is a signatory. While Kenya has made progress in households' overall financial inclusion with use of formal finance products increasing from 26.7% in 2006 to 82.9% in 2019 (FinAccess, 2019a), there still exists disparities in access to some essential products such as credit and insurance. The 2019 FinAccess Household

Survey shows that the share of adult population in Kenya using insurance products was 27.9% while usage of credit products – both formal and informal stood at 50.4% (FinAccess, 2019a). The use of insurance has been largely driven by the government initiatives towards universal health coverage while use of credit was driven by uptake of micro loans through mobile banking (increased from 5.9% in 2016 to 9.5% in 2019) and borrowings from informal sources (credit from shopkeepers rose from 9.9% in 2016 to 29.7% in 2019 while that from social networks such as family/friends increased from 6.6% to 10.1% over the same period). The use of these formal financial instruments varies significantly across geographical regions and socio-economic status such as gender, age, wealth quintiles and rural-urban divide. For instance, the rural and poorer households, and the households with lower education tend to have lower access to formal financial products (FinAccess, 2019a). These segments of the population are often disproportionately vulnerable to climate related hazards as they are predicted to have lower investments in coping measures.

Among the shocks experienced by Kenyan households, droughts and floods was ranked second (the first being large rise in food prices) as per the 2015/16 KIHBS (KNBS, 2018b). Food inflation and consequent reduced food consumption are also linked to climate-induced hazards such as droughts (Hill & Porter, 2017). The 2019 FinAccess Household Survey (FinAccess, 2019a) also ranks shocks attributed to natural disasters as the second major adverse events reported by households. There is however dearth of systematic analyses on how the Kenyan households cope with the impacts of droughts and floods. The extant literature is limited to small geographical areas such as Turkana (Opiyo, Wasonga, Nyangito, Schilling, & Munang, 2015) and Laikipia (Crick, Eskander, Fankhausa, & Diop, 2018a). A more comprehensive analyses would be vital in guiding policy design and interventions. There is also need for deeper analyses disaggregated by finance and non-finance coping measures to better guide policy design and interventions as articulated in the national policies and global aspirations such as the United Nation’s Sendai Framework for Disaster Risk Reduction 2015-2030.

1.2 Statement of the Problem

With predicted increase in climate change, the frequency and severity of droughts and floods are projected to rise significantly (Shiferaw, et al., 2014). These dynamics require building effective coping mechanisms by private sector to mitigate potential losses that stifle developmental outcomes. At the macro level, the Kenyan economy is estimated to lose about 8.0% of GDP every five years due to the impacts of droughts and about 5.5% of GDP every seven years due to the impacts and floods (GoK, 2017). At the micro level, the 2015/2016 KIHBS shows

that 27.3% of the households reported to have been negatively affected by droughts and floods during the five years preceding the survey (KNBS, 2018b). Droughts and floods affect households through various channels; 42.9% suffered income losses; 13.0% suffered asset losses; and 38.8% suffered both income and asset losses (KNBS, 2018b). There are concerns that the households in Kenya rely on informal coping mechanisms such as borrowings from social networks and unsustainable measures such as selling assets and cutting on expenses/consumption, that are likely to intensify their subsequent vulnerabilities to the impacts of droughts and floods (KNBS, 2018a). A deeper understanding of the dynamics of use of different coping mechanisms and the effectiveness of different coping mechanisms in building household resilience would create valuable insights on the design of policy interventions. An issue of interest is also the understanding of constraints to the use of market-based formal coping mechanisms such as insurance and credit as they provide opportunities for risk pooling and diversification across time and households.

1.3 Research Objectives

1.3.1 General Objective

The general objective of the study is to draw lessons from selected interventions targeted at strengthening household coping mechanisms; to analyse choice of coping mechanisms households use to mitigate the impacts of drought and floods, and to assess effectiveness of various coping mechanisms in building household resilience to the impacts of droughts and floods Kenya.

1.3.2 Specific Objectives

The specific objectives are;

- i) To review and draw lessons from selected market-oriented interventions designed to support households in coping with the impacts of droughts and floods in Kenya;
- ii) To identify finance and non-finance coping mechanisms used by households in Kenya to cope with the impacts of droughts and floods;
- iii) To analyse the factors determining choice of finance and non-finance coping mechanisms employed by households to mitigate the impacts of droughts and floods in Kenya;

- iv) To analyse the effects of finance and nonfinance coping mechanisms in improving households' resilience to the impacts of droughts and floods in Kenya.

1.4 The Institutional Framework; Global, Regional and National

This section highlights broad policy framework for building resilience to the impacts of droughts and floods at the household level and provides deeper review of the financial sector structure in Kenya. The focus on the structure of the financial sector hinges on the significance attached to the use of market-based coping mechanisms such as financial instruments for building resilience as articulated in the Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015c).

1.4.1 Global and Regional Policies

The 1992 United Nations Framework Conventions on Climate Change (UNFCCC) lays the foundation for multilateral initiatives on climate change (United Nations , 1992). The key objective of UNFCCC is to stabilise greenhouse gas concentrations to allow ecosystems to adapt naturally and generally to promote sustainable development, including aspects such as food production. The UNFCCC also paved way for later negotiations including the 1997 Kyoto Protocol that commits the UNFCCC Parties to greenhouse emission targets (United Nations , 1997) and the 2015 Paris Agreement (United Nations, 2015b) that among other things aim to strengthen global response to climate change by limiting global temperature rise below 2°C above pre-industrial levels, and strengthen ability of countries to address impacts of climate change through technology, capacity building and financing.

The Sendai Framework for Disaster Risk Reduction 2015-2030 (United Nations, 2015c) underscores a paradigm shift from disaster management to disaster risk management so as to reduce disaster risk and livelihood losses. Other priority areas identified by this policy framework include strengthening of disaster risk governance and accountability for disaster risk management. The partner countries are expected to develop and implement national and local disaster risk reduction strategies and make investments that enhance resilience (United Nations, 2015c). To build resilience for both public and private investments and reduce financial losses, the framework underscores the need to deepen mechanisms for risk transfer and insurance. The predecessor of the Sendai Framework, the Hyogo Framework for Action 2005-2015 (UN/ISDR, 2007) emphasised the need for involvement of both the public and private sectors in development and deepening of insurance and financing of disaster risk reduction activities.

The Sustainable Development Goals (SDGs) (United Nations, 2015a) also has elements on climate related risk reduction. The relevant goals and targets include SDG Goal 1 (Target 1.5) which underscores reduction of exposure and vulnerability to climate extremes); and SDG Goal 11 (Target 11.5) that calls for reduction in the number of people affected and economic losses attributable to natural disasters while Target 11.B requires countries to adopt and implement local disaster risk reduction strategies in accordance with the Sendai Framework for Disaster Risk Reduction 2015-2030). SDG Goal 13 (Target 13.1) requires strengthening of the resilience and adaptive capacity of communities to climate related hazards and natural disasters.

At the regional level the African Union Agenda 2063 (African Union, 2014) requires member countries to prioritise adaptation to climate change as well as measures aimed at supporting climate change mitigation through interdisciplinary approach. The support it identifies include technology, skills development and financial resources. The aspiration to transform Africa through mobilization of domestic resources as envisaged in the AU Agenda 2063 requires robust growth that is resilient to shocks, including those that emanate from climate-induced hazards.

1.4.2 National Level Policy Framework and Coordination Structures

Foremost disaster management is a concurrent function as outlined in the Constitution of Kenya 2010; meaning the function is assigned to both the national government and county governments. The national government is also mandated with national policy development, which county governments are expected to streamline into county-level policies for devolved functions. In this regard, the Ministry of Devolution and ASALs has a mandate of developing policies on ASALs including those related to socio-economic development, special programmes and food relief management. The Ministry of Environment and Forestry protect and manage environment and natural resources to foster socio-economic development.

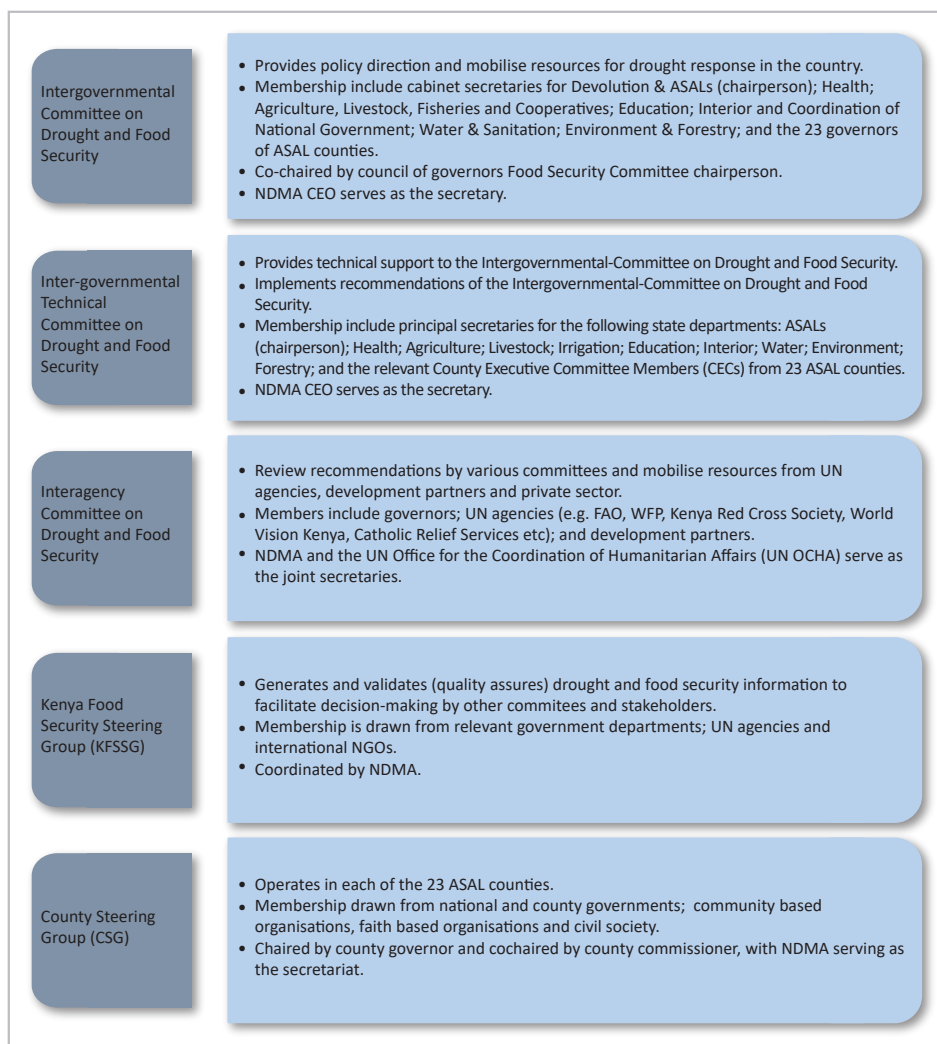
The Kenya Vision 2030 provides the strategic direction in terms of development goals and policy priorities. It is anchored on three pillars: The economic pillar that targets to realise 10% annual GDP growth rates; social pillar centred on building a just and cohesive society with equitable social development in a secure

environment; and the political pillar aimed at a robust democratic political system, respect for the rule of law and protection of the rights of the citizens. The aspirations under the three pillars underscore the imperatives for building household coping mechanisms. The Vision is implemented through five-year Medium-Term Plans (MTPs). The MTPs provide important avenues for reviewing medium term development progress, and opportunities to bring on board emerging issues in line with the long-term development goals. With regards to climate change, the Vision aims at reducing the impacts of disasters including losses resulting from droughts and floods (GoK, 2007). The Third MTP 2018-2022 has identified climate change and disaster risk management as thematic issues that require to be addressed so as to achieve the Kenya Vision 2030 development aspirations (GoK, 2018a). The priority flagship projects in this MTP include development of national integrated drought early warning systems, integrated knowledge management system among others. It also underscores drought risk resilience and climate change adaptation among the programmes to be pursued in the medium term.

In 2015 the National Government developed the Ending Drought Emergencies Common Programme Framework that commits to end drought emergencies by 2022 (GoK, 2015). The framework has six pillars towards ending drought emergencies, including: Peace and security; climate resilient infrastructure; human capital development (health, nutrition and education); sustainable livelihoods; drought risk management; and institutional development and knowledge management. The drought risk management pillar has a strong emphasis on building coping mechanisms, including market-based interventions. The National Drought Management Authority (NDMA) has since its establishment in 2011 played a lead role in the implementation of activities geared towards drought management, including implementation of the Ending Drought Emergencies Common Programme Framework in 23 ASAL counties. The NDMA coordinates drought management initiatives through the County Steering Groups (CSGs) and leverages on other committees (NDMA, 2018) shown in Figure 1.2. The CSGs hold regular meetings at the respective county level and are chaired by county governor and co-chaired by county commissioner with NDMA serving as the secretariat (NDMA, 2018). Some challenges related to CSGs include voluntary basis of participation and bias towards drought management, yet other climate induced shocks including floods is increasingly becoming a policy concern¹.

¹ These arguments are supported by key informant interviews carried out by KIPPRA in 2018

Figure 1.2: Drought and food security management structures in Kenya



Source: Author's construct from NDMA (2018)

The National Disaster Risk Management Policy approved by the cabinet in May 2018 aims to provide the framework for addressing a wide-range of disasters including those resulting from droughts and floods. Among the objectives of this policy include strengthening institutional capacity for disaster risk management; reduced disaster risks vulnerabilities at county and national levels; mainstreaming of disaster risk management into policies across all sectors; enhanced resilience at national and county levels to the impacts of disaster risk and climate change; and enhanced coordination in disaster preparedness, prevention, response and

recovery (GoK, 2017). The policy underscores role of risk reduction, including mechanisms for disaster risk transfer and insurance, risk sharing and financial protection for both public and private sector investments.

Other national policies and legal framework are those that address climate change and adaption. These include the Kenya National Adaption Plan 2015-2030 (GoK, 2016b) and the National Climate Change Action Plan 2018-2022 (GoK, 2018b). The Kenya National Adaptation Plan calls for a holistic climate change adaptation across all sectors of the economy in planning, budgeting and implementation. This five-year framework is a requirement under the Climate Change Act of 2016 (GoK, 2016a) to guide mainstreaming of climate change response, resilience, adaptations and mitigation actions at the national and county government levels. Other provisions of the Climate Change Act 2016 include the establishment of the Climate Change Fund for financing priority climate change actions and interventions; and establishment of the National Climate Change Council comprising of the president (chairperson), deputy president, cabinet secretary handling matters of environment and climate change, as well as the Climate Change Directorate. The National Climate Change Action Plan aims to enhance adaptation to climate change and reduce greenhouse gas emissions at national and county levels.

Other key actors include the National Disaster Management Unit (NDMU) and National Disaster Operations Centre (NDOC). The NDMU was established through a Presidential Directive in August 2013 with a mandate of coordination, monitoring, and response management of disaster efforts (GoK, 2014). It is anchored within the Ministry of Interior and Coordination of National Government. The NDOC was established in 1998, initially mandated to coordinate efforts in mitigating impacts of the El Nino rains on infrastructure and the environment. Other institutions include the Kenya Meteorological Department (KMD) and the Kenya Meat Commission (KMC). KMD is mandated to provide access to meteorological information and services through collection and dissemination of meteorological information; and coordination of research in meteorology and climatology. KMC facilitates livestock offtake to minimize losses emanating from disasters particularly drought in ASAL areas.

Besides the formal institutions so far detailed in this section, communities in some instances have also devised traditional institutional arrangements for better management of natural resources such as pasture and water. An example is the *dedha* council of elders among the Borana community of Northern Kenya; a customary institution for management of natural resources such as pastures on a planned basis. The *dedha* council of elders use deep knowledge of local environment to plan and enforce among its community members provisions regarding

pasture and water usage; and leverages on negotiation of reciprocal agreements with neighbouring pastoral communities to expand pasture diversification opportunities (Tari & Pattison, 2014). It has been shown that strengthening traditional institutions through resource mapping, access to information and linking them with formal institutional arrangements can be beneficial for natural resource management and building resilience of local communities to climate change (Tari & Pattison, 2014). Further, linking traditional/customary institutions such as *dedha* is shown to strengthen the legitimacy of formal institutions and adaptations to climate change, say through better prioritisation and transparency of public investments (Elhadi, 2018).

1.4.3 Financial Instruments and the Structure of Kenya's Financial Sector

Building effective household coping mechanisms to the impacts of climate-induced hazards is recognized as part of the general private sector development initiatives (Crick, Gannon, Diop, & Sow, 2018b). Financial sector development through deepening of financial instruments can lessen households' vulnerability to climate-induced hazards through consumption smoothing, risk pooling and transfer. Global policy initiatives (UN/ISDR, 2007; United Nations, 2015c) as well as national level policies (GoK, 2015) have already prioritized deepening of financial instruments as part of the policy agenda towards enhancing private sector resilience to the impacts of climate-induced risks.

Uninsured risk and challenges in accessing credit often push households in developing countries to employ low risk and low return economic activities that exacerbate poverty in the long run (Shee, Turvey, & Woodard, 2015). Financial instruments are diverse and encompass savings, credit, insurance, investment, pensions and payments products. Both regulated formal financial institutions and informal players that operate outside regulatory framework operate in Kenya, serving various socio-economic groups to varying degrees. The formal financial service providers broadly comprise of banking, insurance, retirement benefits/pensions, the capital market, cooperatives, Microfinance Institutions (MFIs), Development Finance Institutions (DFIs), and mobile money service providers (FinAccess, 2019a). The banking sector, regulated by the Central Bank of Kenya comprise of 42 commercial banks, one mortgage finance company, nine representative offices of foreign banks, 13 microfinance banks, three credit reference bureaus, 19 money remittance providers and 73 foreign exchange bureaus (Central Bank of Kenya, 2018d). The banking sector remains key source of credit to both the private and public sectors.

The cooperative sector is broadly classified into the Savings and Credit Cooperatives (SACCOs), and other types of cooperatives based on their objectives such as investments, marketing and special interest groups. The SACCOs are further classified into deposit taking SACCOs and non-deposit taking SACCOs. Non-deposit taking SACCOs are limited to non-withdrawal deposits often used as collateral for credit to members, while deposit taking SACCOs carry out deposit taking business and services including savings accounts, ATMs, credit cards and money transfers (SASRA, 2017). The SACCO Societies Regulatory Authority (SASRA) regulate and supervise deposit taking SACCOs, standing at 174 in number as of 2018. The non-deposit taking SACCOs are supervised under the Cooperative Societies Act by the Commissioner of Cooperatives. The non-SACCO cooperatives (i.e. 'other' cooperatives) are also supervised by the Commissioner of Cooperatives under the Cooperative Societies Act.

A unique feature of the institutional framework in the cooperatives sector is the dual supervision of deposit taking SACCOs that are subject to the Cooperative Societies Act 490 (which applies to all cooperative societies); and the SACCO Societies Act 490B that is applicable to only deposit-taking SACCOs. As of end of 2018 the deposit taking SACCOs had mobilized KSh. 342.3 billion in deposits and advanced KSh. 358.6 billion in loans and advances (KNBS, 2019). There are about 20,547 cooperatives as of 2018, of which 30% were in the agricultural sector (KNBS, 2019). The rural nature of cooperatives positions them strategically in deepening financial inclusion and savings mobilization, especially among the segments of the population hardly reached by banks and microfinance institutions.

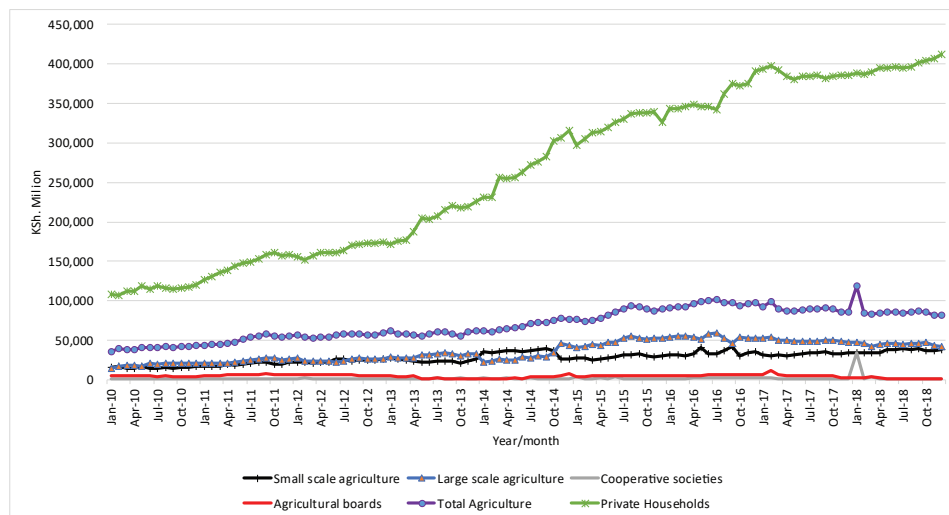
Banking sector lending to the households and agriculture sector is shown in Figure 1.3. Large scale agriculture is the main recipient of bank credit. The growth of credit to various categories of agriculture sector players have generally slowed down post mid-2016. One of the reasons for the slowdown of lending could be due to interest rate capping in 2016², requiring banks to limit interest to four percentage points above the central bank rate. An assessment by the Central Bank of Kenya (CBK) suggests the interest rate capping negatively impacted private sector credit, with reduced lending to smaller borrowers (Central Bank of Kenya, 2018a). The lending to the private households demonstrates largely upward trends although since January 2015 the growth rate has slowed down. The share of credit to households in total private sector credit has increased from 3.3% in 2000 to 16.6% as of December 2018; while the lending to the agriculture sector as a share of total private sector credit has declined from 8.4% to 3.3% over the same period³. The trend therefore shows that the agricultural sector is increasingly

² The interest rate capping was introduced in September 2016 through an amendment of Kenya's Banking Act (Section 33B); which has since been repealed through the Finance Act, 2019

³ Author's calculations from CBK data for various years

being deprived of banking sector credit.

Figure 1.3: Bank lending to households and the agriculture sector: January 2010-December 2018



Data Source: Central Bank of Kenya, 2018b; 2018c

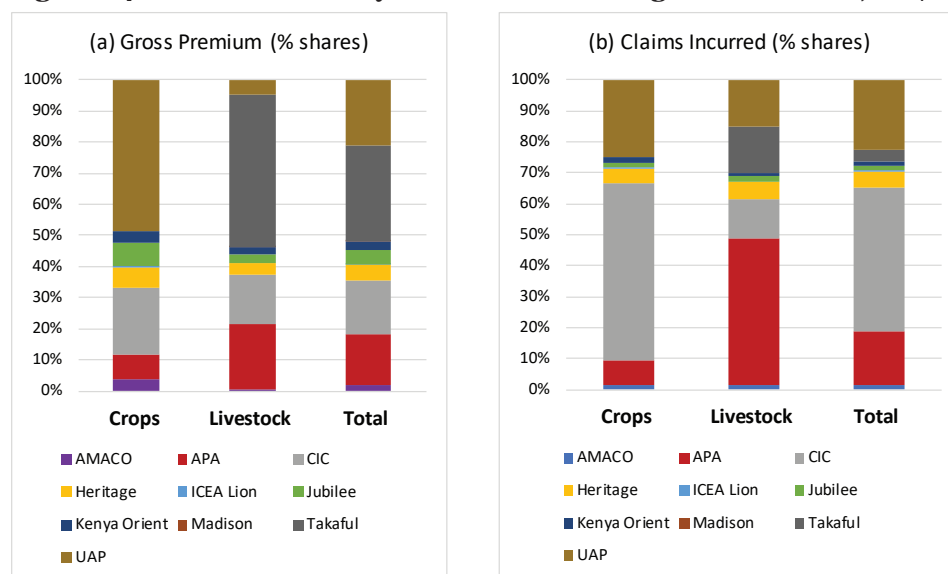
Within the insurance sector, the Insurance Regulatory Authority (IRA) regulates insurance companies, re-insurance companies, insurance brokers, insurance agents, motor assessors, insurance investigators, insurance surveyors, loss adjustors, claim settlement agents, and risk managers (Insurance Regulatory Authority, 2018). As of 2017 there are 52 insurance companies, four reinsurance companies, 221 insurance brokers, 11 reinsurance brokers and 9,348 insurance agents among other licensed insurance industry players (Insurance Regulatory Authority, 2018). Insurance coverage is however limited to urban and industrial counties including Nairobi, Mombasa, Kiambu and Nakuru counties that accounts for about 84 percent of the total industry premium (Insurance Regulatory Authority, 2018). As elaborated in Table 1.1. gross insurance premium to the agricultural sector increased from KSh. 270.4 million in 2014 to KSh. 822.8 million in 2017. Over the same period claims incurred increased from KSh. 175.8 million to KSh. 820 million. The pay-outs for crops significantly increased in 2016 and 2017 as evident from the loss ratio (claims divided by gross premium). This period coincided with the prolonged drought that spanned through 2016 to 2017.

Table 1.1: Agriculture sector gross premium, claims incurred and loss ratio, 2017

| Year | Gross Premium (KSh. Million) | | | Claims Incurred (KSh. Million) | | | Loss Ratio (%) | | |
|------|------------------------------|-----------|-------|--------------------------------|-----------|-------|----------------|-----------|-------|
| | Crops | Livestock | Total | Crops | Livestock | Total | Crops | Livestock | Total |
| 2014 | 227.0 | 43.4 | 270.4 | 146.1 | 29.7 | 175.8 | 64.3 | 68.5 | 65.0 |
| 2015 | 214.4 | 148.2 | 362.5 | 62.6 | 56.2 | 118.8 | 29.2 | 37.9 | 32.8 |
| 2016 | 167.8 | 380.3 | 548.0 | 124.8 | 103.7 | 228.4 | 74.4 | 27.3 | 41.7 |
| 2017 | 303.3 | 519.4 | 822.8 | 621.2 | 198.8 | 820.0 | 204.8 | 38.3 | 99.7 |

Data Source: Association of Kenya Insurers Annual Reports (Association of Kenya Insurers, 2015; 2016; 2017; 2018)

As illustrated in Figure 1.4 four insurance companies: Takaful Insurance of Africa, UAP, CIC and APA accounted for major portions of gross premium (85.9%) as of 2017. With regards to claims incurred, CIC, UAP and APA accounted for a large share (86.5%) of the claims. The differences in the shares of gross premium collected and claims incurred can be explained by the fact that some insurance companies have more exposure to crops loss as compared to livestock loss.

Figure 1.4: Insurance industry statistics related to agriculture sector, 2017

Data Source: Association of Kenya Insurers Annual Report (Association of Kenya Insurers, 2018)

The emergence and deepening of mobile money platforms such as M-Pesa, Airtel money, Equitel money, T-kash and mobile pay continue to play central roles in financial inclusion through mobile money savings, borrowings/credit, remittances

and linkages with other innovative products such as weather insurance. As of December 2018 there were over 32.1 million active mobile money subscriptions spread across the four operators with diverse market shares: M-Pesa (81.3%); Airtel Money (12.7%); Equitel Money (5.4%); T-Kash (0.3%); and Mobile Pay at 0.3% (Communications Authority of Kenya, 2019). Innovative financial products such as weather index insurance (e.g. Kilimo Salama supported by Agriculture and Climate Risk Enterprise Ltd. (ACRE)) are now leveraging on partnerships with mobile money operators to reach clients over a wide geographical base. The 2019 FinAccess Household Survey shows mobile money is among the dominant channels for paying insurance premiums in the country (29.0% of urban households and 36.3% of rural households) and with 25.3% of the adult population using bank products leveraging on mobile banking (FinAccess, 2019a). Mobile money also provides a platform for social transfers by the government and intra-household and inter-household transfers for various uses, including coping with the impacts of drought and floods.

The households in Kenya often use informal financial services in conjunction with formal financial services. Informal financial services commonly used in Kenya include money lenders/shylocks, welfare groups, Rotating Savings and Credit Associations (RoSCAs), Accumulated Savings and Credit Associations (ASCAs), merry-go-rounds/*chamas*, intra and inter-household savings and borrowing. The 2019 FinAccess Household Survey shows 54% of the adult population in Kenya use a combination of formal and informal financial products (FinAccess, 2019b). Loss of savings through informal financial services due to issues such as default by members, dishonesty or fraud is however relatively high compared to formal financial services (Malkamäki, 2011; FinAccess, 2019a), posing challenges in saving for climate shocks over long-term horizon. Climate related shocks affect large proportion of communities concurrently, making use of informal financial instruments less effective. Nonetheless, about 50% of the households in Kenyan resort to the support of social networks when faced with shocks such as sickness, death, loss due to natural disasters and theft (FinAccess, 2019a).

1.4.4 Summary of Review of Institutional Framework

In summary, the review of institutional framework suggests some policy insights. The first is that there exist multiple policies at global and national level addressing the issues of climate change and adaptation to climate change. Kenya has made progress in developing national-level policies towards implementation of the global and regional commitments. Given multiplicity of policies, policy coherence is imperative. Second, there is heavy emphasis on droughts mitigations and adaptations. With climate change, risks from other aspects of climate change such

as floods are on the rise. It is therefore imperative for policies to be comprehensive in addressing the risks of climate change. Third, at the national and county level, there exists multiple institutions addressing drought and food security. These include Intergovernmental Committee on Drought and Food Security; Intergovernmental Technical Committee on Drought and Food Security; Interagency Committee on Drought and Food Security; Kenya Food Security Steering Group; and the County Steering Group. These committees and steering groups have the advantages of bringing on board various policy actors including national government, county governments, development partners, community-based organisations and NGOs at different levels. The NDMA also serves as a member on all these committees and steering groups, which should serve as an important coordination avenue. Voluntary basis of some of these institutions such as the County Steering Groups may however hamper effective coordination. Fourth, there are indications that linking formal institutions and customary/traditional institutions can foster adaptations to climate change and prioritization of public investments. Fifth, market-based interventions from the financial instruments perspective is yet to be well developed, in particular insurance and to some extent credit. This may limit opportunities to leverage on market system for pooling and transfer of climate-induced risks.

2. Literature Review

2.1 Theoretical Literature

Natural resource-dependent households disproportionately suffer the adverse consequences of climate change hazards such as droughts, floods, storms and heat waves that drive them into poverty and hunger (Agrawal & Perrin, 2009). Some of these hazards including droughts and floods impact on households through reduced livelihood options and income volatility especially in agro-climatic zones that are relatively prone to such risks (Agrawal & Perrin, 2009). Coping with risks can occur at two levels; income smoothing through conservative production, employment choices and diversification of economic activities (Morduch, 1995). Such ex-ante measures are expected to cushion households from income shocks before the triggers of the shocks occur. Alternatively, households can employ actions geared towards consumption smoothing through measures such as borrowing and saving, accumulation and depletion of non-financial assets, labour supply adjustments, and use of formal and informal insurance measures (Morduch, 1995). These ex-post measures are aimed at cushioning consumption patterns from variability in income induced by external shocks such as those resulting from droughts and floods. Households may however use a combination of income smoothing and consumption smoothing coping measures. The extent to which households employ income smoothing coping measures are contingent on the degree of the risk and risk aversion, as well as availability of consumption smoothing measures (Morduch, 1995). Coping measures such as production choices can be costly if households chose to engage in lower risk (e.g. opportunities that are less prone to climate shocks) at the expense of higher factor returns, leading to efficiency losses. Use of financial instruments such as insurance can however create incentives for households to allocate resources to more profitable but relatively risky economic activities (Morduch, 1995). With regards to the use of credit and insurance products, the constraints in using them for consumption smoothing may go beyond nonexistence of such markets to include high transaction costs, information asymmetry and costs of enforcing contracts (Morduch, 1995) that tend to disproportionately affect poorer households. Certainly, the consumption smoothing framework corroborates the life cycle theory of consumption (Modigliani & Brumberg, 1954; Modigliani & Brumberg, 1980) which postulates that financial behaviour of individuals vary over the life cycle, meaning behaviours such as saving rates increases during working years but decreases over time and may even become negative in retirement as income diminishes. The implication is that the lifecycle of an individual may shape the extent and nature of coping mechanisms used in particular from financial instruments and income choices

perspectives. The consumption smoothing framework and the life cycle theory of consumption have a common underpinning in terms of deliberate efforts by individuals to maximise consumption utility in future.

The shocks resulting from climate-induced hazards cause uncertainty in future income. The precautionary theory of demand for savings (Leland, 1968) argues that demand for saving is a positive function of uncertainty. Thus, precautionary saving is seen as a moderation of current consumption in favour of maintaining the same utility of consumption in subsequent periods that can be subject to reduced income due to shocks. Certainly, other dynamics such as returns on savings, access to credit and insurance would moderate the extent to which precautionary savings hypothesis holds (Lugilde, Bande, & Riveiro, 2019).

Coping measures are also shaped by institutions, especially informal constraints and opportunities that shape how individuals, households and communities respond to climate risks and how the costs of risks are distributed among the community members (Agrawal & Perrin, 2009). The specific channels through which institutions (constraints and opportunities) shape risks and impact households include adaptation practices such as mobility, storage, diversification of livelihood sources, communal pooling and market exchanges. Arrangements for external interventions such as supply of climate information and financing arrangements that support investments in technology can determine choices households make in coping with droughts and floods. Institutional arrangements also define property rights (Agrawal & Perrin, 2009), which can in turn influence use of market-based arrangements as coping mechanisms. Socio-economic endowments such as wealth and social networks may define coping mechanisms across income groups. The main viewpoint of the institutional approach to coping mechanisms is that adaptations to climate change are largely local and therefore local institutions should be integrated into the design of adaption policies and programmes.

Resilience involves capacity to absorb and withstand shocks resulting from hazards such as droughts and floods without suffering adverse long-term outcomes (Holling, 1973; FAO, 2016). The concept of resilience originated from ecological literature (Holling, 1973), where it was argued household characteristics, community and ecological features affect the household resilience. The perspectives on sustainable livelihoods approach view household resilience to shocks from a more micro socio-economic standpoint (Scoones, 1998; Barret & Constanas, 2014), postulating role of factors such as financial capital, human capital, social capital, livelihood options and diversification, and institutional arrangements that support or hinder integration of different livelihood strategies. When households face risks induced by hazards such as droughts and floods, coping mechanisms are triggered either

ex-ante or ex-post. The institutional and agro-climatic contexts may however determine the extent to which the households remain resilient. The opportunity space in form of decisions and pathways to climate-change adaptation (IPCC, 2014) that leads to resilience outcomes can be shaped by household, community, institutional and agro-ecological characteristics.

2.2 Empirical Literature

The magnitude of adverse impacts of droughts and floods in developing countries is immense. Drought alone accounts for 25% of all natural disasters in Africa compared to 8% global average, and the increasing extreme events and drought frequencies in the East African region raises policy concerns (Gautman, 2006). Climate related hazards affect large number of households simultaneously; making use of informal coping mechanisms such as use of social networks and self-insurance (e.g. sale of asset, use of stock reserves) ineffective as measured by outcome indicators such as consumption and child nutrition (Skoufias, 2003). Increasing recurrence is particularly of policy concerns when households rely on informal coping mechanisms as they become more vulnerable in subsequent periods.

The effectiveness of ex-ante and ex-post coping mechanisms and hence the extent to which they are utilised depend on agro-climatic and socio-economic conditions (Shiferaw, Tesfaye, Kassie, Abate, Prasanna, & Menkir, 2014). This may be attributable to the dynamics of impacts of natural disasters that vary with socio-economic and agro-climatic conditions. For instance, households within communities with higher mean incomes and less inequality are found to be more resilient to the impacts of droughts and floods (Arouri, Nguyen, & Youssef, 2015). It is argued households that are wealthier have better market-based coping mechanisms than poorer households (Greiving, 2006), which is plausibly corroborated by evidence showing that damages caused by natural disasters as a proportion of GDP is relatively higher in developing countries (Okuyama & Sahin, 2009). Wealthy households have better access to markets and coping instruments such as insurance, credit, savings and assets to smooth their consumption patterns when climate-induced hazards strike (Tran, 2015). In Kenya, the increased severity of droughts have severely impacted pastoral livelihoods, demanding adoption of more diverse and long-term coping mechanisms such as diversification of livelihood sources, increased livestock mobility, diversification of herd composition towards those that are more disease and drought tolerant, and human capital investments such as enrolling children in school for future incomes (Opiyo, Wasonga, Nyangito, Schilling, & Munang, 2015).

Coping mechanisms to mitigate the impacts of drought and floods can be ex-ante or ex-post. Ex-ante measures include conservative approaches such as engaging in production choices that are perceived to be less risky, use of less production inputs and reallocation of investments to more liquid assets to serve as precautionary savings (Hansen, Dilley, Goddard, Ebrahimian, & Ericksen, 2004). Ex-post coping measures are taken after drought or flood has occurred and can comprise reducing risk through flexible decision making (Shiferaw, Tesfaye, Kassie, Abate, Prasanna, & Menkir, 2014). The magnitudes of the ex-ante and ex-post costs of climate related losses imply that focusing attention only on losses after drought or flood has occurred is only a partial picture. The implications are also that some coping mechanisms have costs embedded in them. For instance, coping mechanisms such as liquidation of productive assets, termination of schooling and environment degradation activities including charcoal burning make households more vulnerable subsequently (Hansen, Dilley, Goddard, Ebrahimian, & Ericksen, 2004; Shiferaw, Tesfaye, Kassie, Abate, Prasanna, & Menkir, 2014). Some costs such as increased food prices, unemployment and spread of diseases are indirect (Hansen, Dilley, Goddard, Ebrahimian, & Ericksen, 2004), which may make coping mechanisms employed quite diverse.

Market-exchange mechanisms ideally are expected to deepen use of financial instruments that support households cope with adverse impacts of droughts and floods. Access to risk transfer instruments such as insurance cushion resource-poor households against climate variability while concurrently deepening uptake of productivity-enhancing economic choices (Shiferaw, Tesfaye, Kassie, Abate, Prasanna, & Menkir, 2014). While conventional insurance and credit are well developed in advanced economies, households in developing economies lack access to these instruments due to underdeveloped nature of financial markets. For instance, development of conventional agricultural insurance that hinges on loss indemnity is constrained by among other things high overhead costs that includes monitoring costs, profiling of risks and collation of actuarial data (Jensen & Barret, 2017). These challenges have motivated development of weather-related insurance that is linked to index such as rainfall, temperature, humidity or crop yields (Alderman & Haque, 2007). Index based insurance is designed to lower transaction costs including those that arise from information asymmetry in the insurance market (Alderman & Haque, 2007). Besides, access to such insurance aid in deepening of credit market as it signals lower risk of default to creditors (Carter, Cheng, & Sarris, 2016). The growth of index-based insurance, despite its attractiveness is however shown to be constrained by liquidity constraints among poorer households, low financial literacy, weak trust of insurance providers, cultural and religious barriers (Jensen & Barret, 2017). There are also limitations

related to basis risks, which means that the index may only partially capture the actual loss suffered by the household (Jensen & Barret, 2017).

Prior studies have attempted to establish the determinants and effectiveness of different coping mechanisms in building resilience to droughts and floods. Households with higher incomes, access to credit, remittances and social support are shown to demonstrate more resilience to climate-change related hazards such as droughts, floods and storms (Arouri, Nguyen, & Youssef, 2015). The measurements of effectiveness of coping mechanisms are usually done within resilience at micro level, sectoral or macroeconomic level (Arouri, Nguyen, & Youssef, 2015). Micro level resilience is argued to be related to household coping capacity through channels including employment of resources that can withstand impacts of climate-induced risks (Greiving, 2006). Geographical residence is also shown to affect household resilience, with those residing in highlands demonstrating better resilience compared to lowland residing ones (Boka, 2017). These findings can be linked to exposures inherent in different agro-climatic conditions. Access to climate information such as early warning and access to information on climate change adaptation have as well been shown to strengthen household resilience across various climatic regions (Boka, 2017). Access to information and early warnings possibly aid households in planning and taking appropriate coping mechanisms. Consistent with the sustainable livelihood theoretical views (Scoones, 1998; Barret & Conostas, 2014); human capital investment such as education also tend to be associated with better resilience (Boka, 2017) which perhaps suggests opportunities that accrue to education through channels including livelihood opportunities and evaluation of alternative coping decisions.

One challenge with resilience is on its measurements. Given the measurement difficulties, a direct or indirect proxy is usually used to capture resilience (FAO, 2016). Direct measures of resilience rank households in terms of ability to withstand shocks while indirect measure considers aspects affecting it such as speed of recovery or magnitude of impacts using statistical methods (FAO, 2016). Some quantitative studies on resilience measures use consumption or income as the explained variable and socio-economic, community and agro-climatic variables as the covariates (Arouri, Nguyen, & Youssef, 2015; Gao & Mills, 2018). Other studies use indicator dependent variables such as health or food security outcomes (Lohmann & Lechtenfeld, 2015) as a measure of household resilience.

3. Methodology

3.1 Data and Data Sources

The study used a combination of secondary and primary data sources as elaborated in the following subsections.

3.1.1 Secondary Data Sources

This included review of relevant literature and policy framework, relevant selected interventions, focusing on the potential for mitigating the adverse impacts of droughts and floods. The study reviewed ongoing initiatives such as the Index-Based Livestock Insurance (IBLI) piloted and rolled out by the International Livestock Research Institute (ILRI) in partnership with public, private and development partner institutions; agricultural insurance supported by Agriculture and Climate Risk Enterprise (ACRE) Africa; the Kenya Livestock Insurance Programme (KLIP) rolled out by the national government in collaboration with development partners and local financial institutions; and the Boma Project in Northern Kenya, which is a non-profit NGO targeting to support women through entrepreneurship and graduation out of poverty. The selection of these reviews considered interventions being undertaken by both public and non-state actors. The insights from the reviews of these programmes was complemented by analysis of a cross-sectional secondary data from the 2015/2016 Kenya Integrated Household Budget Survey (KIHBS) that covered a range of socio-economic household characteristics, and shocks to households (KNBS, 2018a). The 2015/2016 KIHBS comprised of 24,773 sampled households. The survey spanned over period of 12 months (September 2015 - August 2016) across all the 47 counties of Kenya (KNBS, 2018b).

3.1.2 Primary Data Sources

A cross sectional survey of households was administered in a sample of 27 counties that are prone to droughts and floods. Among the 27 counties, 22 counties (81.5%) are classified as ASALs as detailed in Annex 2. Sampling was done with the help of the Kenya National Bureau of Statistics (KNBS). The sample was drawn from the National Sample Survey and Evaluation Programme V (NASSEP V), which was the household sampling frame in existence at the time of the survey. A total of 1,500 households were sampled through a two-stage sampling design, where in the first stage 150 clusters were selected from the identified counties, and in the second stage, 10 households were selected from each cluster. Wajir county

with 5 clusters (50 households) was dropped during the survey due to heightened insecurity at the time of the survey. The survey was undertaken between 10th February and 10th March 2018 through interviewer administered questionnaires. On completion of the field work the data was cleaned and weighted. Additional primary data was collected through key informant interviews with financial institutions (banks and insurance companies), community-based organisations and government institutions that support the households in coping with climate change induced hazards.

3.2 Conceptual Framework

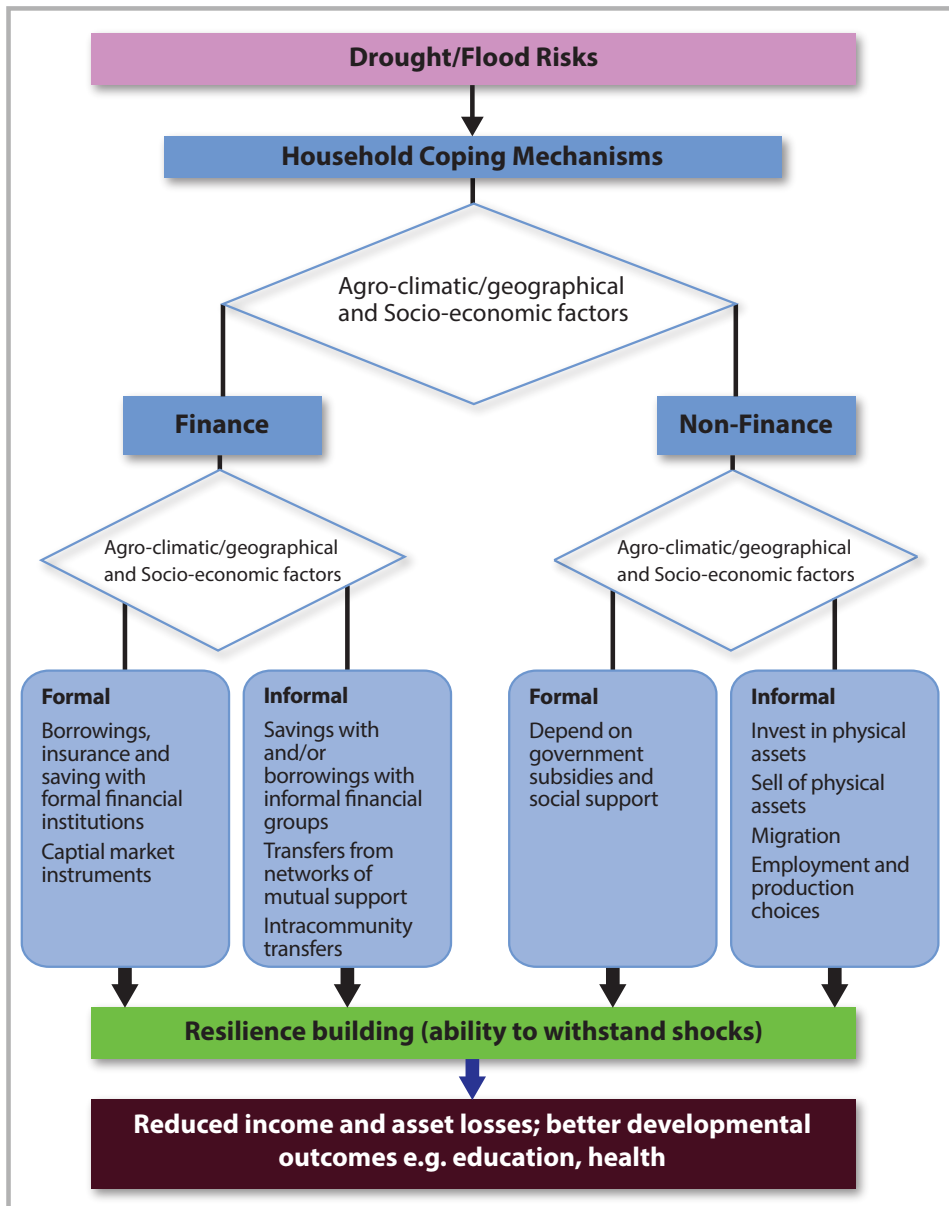
An important goal of households coping mechanisms with risks of droughts and floods is to mitigate disruptions to consumptions and livelihoods with the aim of remaining resilient. Households' can undertake finance and/or non-finance coping mechanisms geared towards *income* and *consumption smoothing*. *Income smoothing* entails mechanisms such as production choices, employment choices or diversification of income sources, and forms ex-ante measures used to cushion oneself against income shocks before they occur (Morduch, 1995). *Consumption smoothing* on the other hand entail activities such as saving and borrowing, insurance contracts, adjustments to labour supply, and liquidation of nonfinancial assets. These coping mechanisms are usually ex-post as they are employed once shocks have occurred and are aimed at cushioning households against consumption variability (Morduch, 1995). Finance coping mechanisms refer to employment of financial products, which can be formal or informal. Formal financial products are offered by operators such as banks, insurance companies, capital market intermediaries and SACCOs that are regulated or supervised by statutory government agencies, government departments and ministries (FinAccess, 2019b). Informal financial products are those offered by non-regulated or non-supervised operators such as money lenders or informal groups. Non-finance coping measures are those that fall outside the realm of financial coping mechanisms in the sense that they are not part of financial instruments (savings, credit, savings, insurance, payments or investment), whether formal or informal. They can be provided by government in form of social transfers, subsidies, and asset transfers (World Bank , 2001). But they can also be non-public measures such as migration, production choices, and selling of physical assets (World Bank , 2001). Formal non-finance coping mechanisms are mostly those that are provided by the government while informal non-finance coping mechanisms are mostly individual-based or community-based actions.

Figure 3.1 illustrates typology of household coping mechanisms with the impacts of droughts and floods. Households' socio-economic characteristics, geographical and agro-climatic attributes create opportunities and constraints that shape the feasible set of coping mechanisms. The basic economic idea is that households as private agents strive to maximize utility, U , determined by goods (X) and climate variable (C); that is $\max U(X,C)$ subject to $Y = PX$ where Y is income and P prices (Mendelsohn, 2012). A utility maximising household would choose a coping mechanism if the net benefit of choosing it (i.e. reduced risk or impacts minus cost of choosing/using it) is higher compared to not choosing the option (Mulwa, Marenya, Rahut, & Kassie, 2017). Climate-induced shocks affects the constraints: Y (mostly expected to decline) and/or P (mostly expected to increase) thus making households worse off. The households are incentivised to make coping decisions so as to maintain utility at pre-shock constant (\bar{U}) level or even better move to a higher utility level ($\hat{U} > U$).

The coping mechanisms can be individual-based, household-based or group-based depending on the actors involved in the decision-making (Skoufias, 2003). As an extension of the consumption smoothing framework, this study adopts the sustainable livelihoods and the social risk management approach (World Bank, 2001) to motivate resilience aspects. In resilience analyses a common approach to examine the impacts of weather related shocks is to analyse change in some variable(s) such as consumption (measured as household total expenditure, or qualitative household reporting such as whether consumption increased, remained constant or decreased during the most recent weather shocks) and linking it to a set of covariates such as institutional, agro-climatic and household characteristics (Gao & Mills, 2018).

Use of finance as a coping mechanisms is given prominence both in literature and policy. The channels through which financial instruments build resilience at the household level include pooling of risk, risk transfer and consumption smoothing. Moreover, financial instruments such as insurance are expected to provide collateral for accessing complementary benefits such as crowding-in of credit (Jensen & Barret, 2017). Insurance helps in transferring covariate and catastrophic losses with institutions such as banks and microfinance institutions facilitating saving and borrowing to cushion households against recurring and less severe shocks (Yang, 2010). The constraints in accessing formal financial instruments can limit opportunities for production decisions especially where such decisions are perceived to be prone to adverse impacts of weather-related hazards. Such dynamics have implications for diversification of livelihoods and investments in otherwise high yield economic activities. The covariate nature of impacts of droughts and floods make the risk pooling role of formal financial products particularly of policy appeal.

Figure 3.1: Conceptual framework of household coping mechanisms and resilience



Source: Author's Conceptualization

3.3 Analytical Approach and Econometric Model

To answer objective (1) review and synthesis of literature was used to draw lessons from the reviewed interventions; corroborated by key informant interviews carried out during the 2018 KIPPRA Survey that was qualitatively analysed across thematic areas. Selected interventions encompass programmes involving the government, research institutions, development partners and non-state actors. In addressing research objectives (2) descriptive statistics was used while for analysing objectives (3) and (4) econometric approach was employed. The use of econometrics was intended to gain two perspectives. The first was to deepen insights on the factors determining the coping choices with regards to finance and non-finance coping mechanisms. Within the finance coping mechanisms, further insights were explored on the choices of formal and informal finance coping measures. Similar approach was used on the use of formal non-finance coping mechanisms and informal non-finance coping mechanisms. The second perspective was to deepen insights on how uses of different coping mechanisms (finance and non-finance) affect the resilience of households towards the impacts of drought and floods.

The characteristics of the dependent variable usually determine the nature of the econometric model to be used. A unique feature of households' coping mechanisms towards climate-induced risks is the use of multiple strategies to benefit from complementarities or substitutability (Mulwa, Marenya, Rahut, & Kassie, 2017; Crick, Eskander, Fankhausa, & Diop, 2018a). It is therefore ideal to utilise econometric models that would allow for the effects of covariates on the coping mechanisms to be determined simultaneously while allowing for the error terms of various coping strategies to be correlated. Typically in such cases bivariate Probit model (Crick, Eskander, Fankhausa, & Diop, 2018a) or in case of more than two equations multivariate Probit model (Mulwa, Marenya, Rahut, & Kassie, 2017) are employed to simultaneously estimate the probabilities of the households' use of different coping mechanisms . The model is derived from the underlying latent variables as follows (Greene, 2018):

$$y_1^* = x_1' \beta_1 + \varepsilon_1, \quad y_1 = 1 (y_1^* > 0), \dots\dots\dots (1a)$$

$$y_2^* = x_2' \beta_2 + \varepsilon_2, \quad y_2 = 1 (y_2^* > 0), \dots\dots\dots (1b)$$

$$\begin{pmatrix} \varepsilon_1 \\ \varepsilon_2 \end{pmatrix} | \mathbf{x}_1, \mathbf{x}_2 \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} 1 & \rho \\ \rho & 1 \end{pmatrix} \right] \dots\dots\dots (1c)$$

The errors are jointly normally distributed with:

Means 0 ; $\sum (\varepsilon_1) = \sum (\varepsilon_2) = 0$; (2a)

Variances 1 ; $var (\varepsilon_1) = var (\varepsilon_2) = 1$; (2b)

Correlation ρ ; $cov (\varepsilon_1, \varepsilon_2) = \rho$; (2c)

The analysis of bivariate Probit model entails obtaining the values for β_s and ρ through maximum likelihood. The ρ reflects conditional tetrachoric⁴ correlation between y_1 and y_2 . The set of explanatory values (\mathbf{x}) in the two equations can be the same or different. In this study \mathbf{x} include household socio-economic characteristics, geographic and agro-climatic variables, while y_1 and y_2 are the coping choices. The bivariate Probit model leads to four possible outcomes:

$$P_{oo} = P (y_1 = 0, y_2 = 0) \dots\dots\dots (3a)$$

$$P_{io} = P (y_1 = 1, y_2 = 0) \dots\dots\dots (3b)$$

$$P_{oi} = P (y_1 = 0, y_2 = 1) \dots\dots\dots (3c)$$

$$P_{ii} = P (y_1 = 1, y_2 = 1) \dots\dots\dots (3d)$$

The probabilities of choosing coping mechanisms (i.e. finance vs. non-finance; formal finance vs. informal finance; formal non-finance vs. informal non-finance) are represented by P_{oo} ; P_{io} ; P_{oi} ; P_{ii} ; where:

P_{oo} is probability of selecting neither of the coping mechanisms; y_1 nor y_2 .

P_{io} is probability of selecting coping mechanism y_1 but not y_2 .

P_{oi} is probability of selecting coping mechanism y_2 but not y_1 .

P_{ii} is the probability of selecting both coping mechanisms y_1 and y_2 .

Three sets of regressions ((i) finance vs. non-finance; (ii) formal finance vs. informal finance; and (iii) formal non-finance vs. informal non-finance)) were estimated separately for droughts and floods (combined); droughts only and floods only as summarised in Table 3.1.

⁴ Tetrachoric correlation is used to measure correlation ('rater agreement') for two dichotomous variables

Table 3.1: Type of coping mechanisms and possible outcomes of bivariate probit models

| Type of Coping mechanisms | Possible Outcomes of bivariate Probit Model |
|--|--|
| Finance and/or non-finance coping mechanisms (y_1 =Finance coping mechanisms; y_2 =Non-finance coping mechanisms) | P_{00} : Neither finance nor non-finance coping mechanism was employed |
| | P_{10} : Only finance coping mechanism was employed |
| | P_{01} : Only non-finance coping mechanism was employed |
| | P_{11} : Finance and non-finance coping mechanism are employed |
| Formal finance and/or informal finance coping mechanisms (y_1 =Formal finance coping mechanisms; y_2 =Informal finance coping mechanisms) | P_{00} : Neither formal finance nor informal finance coping mechanism was employed |
| | P_{10} : Only formal finance coping mechanism was employed |
| | P_{01} : Only informal finance coping mechanism was employed |
| | P_{11} : Formal finance and informal finance coping mechanisms are employed |
| Formal non-finance and/or informal non-finance coping mechanisms (y_1 =Formal non-finance coping mechanisms; y_2 =Informal non-finance coping mechanisms) | P_{00} : Neither formal non-finance nor informal non-finance coping mechanism was employed |
| | P_{10} : Only formal non-finance coping mechanism was employed |
| | P_{01} : Only informal non-finance coping mechanism was employed |
| | P_{11} : Formal non-finance and informal non-finance coping mechanisms are employed |

Source: Author's construct

The following two latent variable models are estimated for each of the three categories of coping choices illustrated in Table 3.1, from which bivariate Probit model is derived as per equations 1a - 1c:

$$y_{1i}^* = \beta_0 + \beta_1 cluster_i + \beta_2 hhsizе_i + \beta_3 hhincome_i + \beta_4 educ_i + \beta_5 age_i + \beta_6 agesq_i + \beta_7 gender_i + \beta_8 asal_i + \varepsilon_i$$

$$y_{2i}^* = \alpha_0 + \alpha_1 cluster_i + \alpha_2 hhsizе_i + \alpha_3 hhincome_i + \alpha_4 educ_i + \alpha_5 age_i + \alpha_6 agesq_i + \alpha_7 gender_i + \alpha_8 asal_i + u_i$$

The errors ε_i and u_i are jointly normally distributed as elaborated in equation (1c) The covariates variables are: *cluster* is whether the household resides in urban or rural cluster; *hhsizе* is the household size; *hhincome* is the number of household income earners; *age* is age of the household head; *agesq* is the squared age of household head to cater for possible nonlinearities; *gender* is the gender

of the household head and *asal* is ASAL classification of the county in which the household resides based on aridity levels. The details on variable explanations, including levels of measurements and codes, where applicable are provided in Table 3.2.

The resilience measure is operationalized using a proxy as suggested in literature (FAO, 2016); in this case as to whether the household had gone without enough food for any of the 12 months preceding the KIPPRA Survey (February 2017 – January 2018), coded 1 (lacked enough food for at least one month) or zero otherwise. The dependent variable in this case is binary for resilience building. The binary nature of the dependent variable in the resilience equation makes use of binary response models such as Logit or Probit appropriate, with estimations obtained by maximum likelihood methods. While the two models usually give similar results, Probit is often favoured given its assumption of the normality of the error distribution that is ideal for some specification problems to be addressed because of the underlying assumptions (Wooldridge, 2013). In a binary response model, the focus is on the response probability which can be expressed as:

$$P(y = 1|\mathbf{x}) \dots\dots\dots (4)$$

Such that \mathbf{x} is a vector of explanatory variables. The Probit model is usually derived from an underlying latent variable y^* , that it is related to the observed explanatory variables, \mathbf{x} , by the following structural model:

$$y_i^* = \mathbf{X}\boldsymbol{\beta} + e_i \dots\dots\dots (5)$$

The continuous latent y_i^* is assumed to be linearly related to the \mathbf{x} through structural equation (5). The relation between the binary observed y and the continuous latent variable y^* is defined by measurement Equation (6) as follows (Long & Freese, 2014):

$$y_i = \begin{cases} 1 & \text{if } y_i^* > 0 \\ 0 & \text{if } y_i^* \leq 0 \end{cases} \dots\dots\dots (6)$$

The Probit model assumes e is independent of \mathbf{x} , and is symmetrically distributed about 0. In this case the probability of outcome would be:

$$P(y = 1|\mathbf{x}) = P(y^* > 0|\mathbf{x}) = P(\mathbf{x}\boldsymbol{\beta} + \varepsilon > 0) = \varepsilon > -\mathbf{x}\boldsymbol{\beta} = P(\varepsilon < \mathbf{x}\boldsymbol{\beta}) = \boldsymbol{\Phi}(\mathbf{x}\boldsymbol{\beta}) \dots\dots (7)$$

Where $\boldsymbol{\Phi}(\cdot)$ is the standard normal cumulative distribution function (cdf). In the resilience equation \mathbf{x} is a vector of household socio-economic characteristics, use

of formal financial instruments, as well as geographic and agro-climatic variables. The derivation of probabilities of observed outcomes depends on whether the covariate is categorical or continuous. For a categorical covariate, marginal effects measure discrete change of predicted probabilities for cases in one category compared to the base category. For a continuous covariate, marginal effects measure instantaneous rate of change.

The following latent variable resilience equation is estimated, from which univariate Probit model is derived as per equation 6:

$$y_i^* = \gamma_o + \gamma_1 cluster_i + \gamma_2 hhsz_i + \gamma_3 hhinc_i + \gamma_4 educ_i + \gamma_5 gender_i + \gamma_6 finance_i + \gamma_7 nonfinance_i + \gamma_8 asal_i + e_i$$

The errors e_i are jointly normally distributed. The covariates variables are: *cluster* is whether the household resides in urban or rural cluster; *hhsz* is the household size; *hhinc* is the number of household income earners; *gender* is the gender of the household head and *asal* is ASAL classification of the county in which the household resides based on aridity levels. The variables *finance* and *nonfinance* refers to use of finance and non-finance coping measures, respectively. The details on variable explanations, including levels of measurements and codes, where applicable are provided in Table 3.2.

3.4 Variable Measurements for Regression Analysis

Analysis of Choice of Coping Mechanisms

The dependent variables and the covariates used in the analyses, together with their measurements are detailed in Table 3.2. Note that three bivariate probit models are estimated. The first model combines the responses for droughts and floods. The second model is restricted to the responses on coping with droughts, while the third model focuses on coping with floods. Disaggregating analyses for droughts and floods can create insights given possible different dynamics of droughts and floods. For instance, droughts are generally slow-onset phenomenon while floods are generally sudden-onset phenomenon. Within each model, analyses first consider use of finance and non-finance coping mechanisms; with subsequent sub-analysis considering formal finance and informal finance coping mechanisms, and then formal and informal nonfinance coping mechanisms. The sub-analyses are intended at obtaining deeper insights on household coping mechanisms.

Table 3.2: Variable descriptions for choice of coping measures

| Variable Label and Description | Variable Measurement Level | Variable Codes |
|--|----------------------------|--|
| <i>Dependent Variables</i> | | |
| Model 1: Finance and non-finance coping mechanisms | Nominal | If use finance coping mechanisms coded 1, 0 otherwise. If use non-finance coping mechanisms coded 1, 0 otherwise. |
| Model 2: Use of formal and informal finance | Nominal | If use formal finance coping mechanisms coded 1, 0 otherwise. If use informal finance coping mechanisms coded 1, 0 otherwise. |
| Model 3: Formal non-finance and informal nonfinance | Nominal | If use formal non-finance coping mechanisms coded 1, 0 otherwise. If use informal non-finance coping mechanisms coded 1, 0 otherwise. |
| <i>Explanatory Variables</i> | | |
| <i>cluster</i> : Cluster type | Nominal | 1 = Urban; 0 = Rural |
| <i>hsize</i> : Household Size (No. of HH members) | Ratio | n/a |
| <i>hhincome</i> : No. of HH income earners | Ratio | n/a |
| <i>educ</i> : HH years of education completed | Ratio | n/a |
| <i>age</i> : Age of HH head | Ratio | n/a |
| <i>agesq</i> : Age of HH head squared | Ratio | n/a |
| <i>gender</i> : HH head Gender | Nominal | 1 = Male; 0 = Female |
| <i>asal</i> : County ASAL classification (Ministry of Devolution and ASAL, 2018) | Nominal | 0 = Non-ASAL; 1 = Semi-arid: 10-29% aridity; 2 = Semi-arid: 30-84% aridity; 3 = Arid: 85-100% aridity |

Source: Author's compilation

Analysis of Factors Affecting Household Resilience

This section of the analyses is concerned with effects of household socio-economic characteristics, geographical location and choice of use of finance and non-finance coping measures on resilience. Such analyses would guide policy in terms of areas for interventions with regards to building household resilience to the impact of drought and floods. The variable labels, their descriptions, measurement levels and the codes for categorical variables are detailed in Table 3.3.

Table 3.3: Variable descriptions for household resilience

| Variable Label and Description | Variable Measurement Level | Variable Codes |
|---|----------------------------|---|
| Dependent variable measuring whether the household spent any of the 12 months preceding the survey without food | Nominal | 1 = Lacked food for at least one of the 12 months; 0 = Had food for 12 months |
| Explanatory Variables | | |
| <i>cluster</i> : Cluster type | Nominal | 1 = Urban; 0 = Rural |
| <i>hsize</i> : Household Size (No. of household members) | Ratio | n/a |
| <i>hhincome</i> : No. of household income earners | Ratio | n/a |
| <i>educ</i> : Household head years of education completed | Ratio | n/a |
| <i>gender</i> : Gender of household head | Nominal | 1 = Male; 0 = Female |
| <i>finance</i> : Financial coping measure | Nominal | 0 = None; 1 = Informal finance; 2 = Formal finance |
| <i>non-finance</i> : Non-finance coping measure | Nominal | 0 = None; 1 = Informal non-finance; 2 = Formal non-finance |
| <i>asal</i> : County ASAL classification based on aridity levels (Ministry of Devolution and ASAL, 2018) | Nominal | 0 = Non-ASAL; 1 = Semi-arid: 10-29% aridity; 2 = Semi-arid: 30-84% aridity; 3 = Arid: 85-100% aridity |

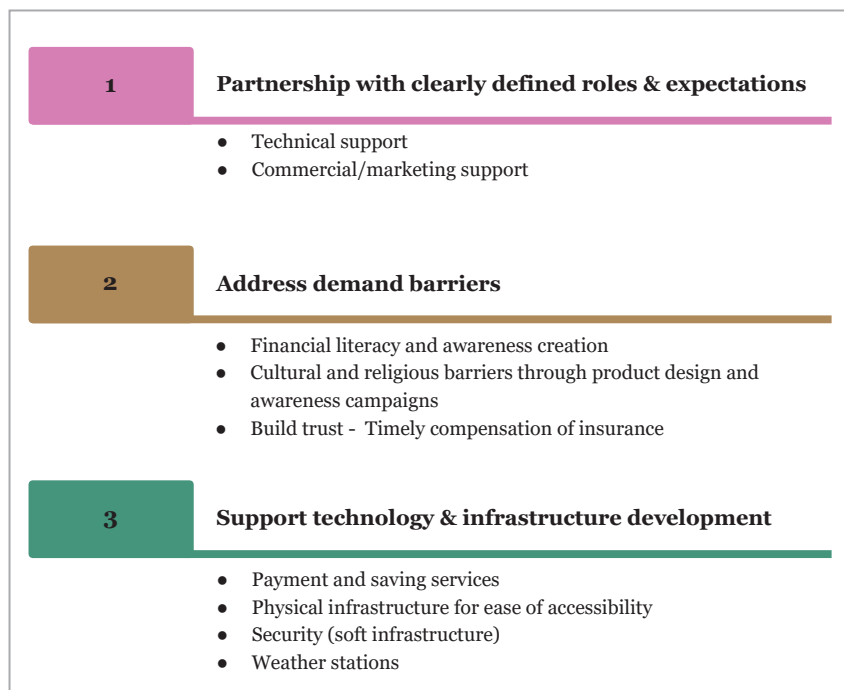
Source: Author's compilations

4. Results and Discussions

4.1 Review of Selected Market Based Interventions and Social Support Programmes

Various interventions have been rolled out within the last decade to cushion households practicing crop farming and livestock keeping against adverse weather shocks. Some interventions are targeted towards either crop insurance or livestock insurance, while others target both. Other interventions are targeted towards long-term adaptations through entrepreneurial support that is expected to diversify livelihood sources. Moreover, some interventions especially those provided by the government are in form of social transfers that act as a short-term insurance for consumption smoothing. The reviews of selected programmes are provided in Table 4.1. In summary, the review of these interventions point suggests three key success areas (Figure 4.1): Well-established partnerships and collaborations with clearly defined roles and expectations; overcoming demand barriers and deepening the supportive technology and infrastructure. These three thematic areas form an important market-based coping ecosystem and architecture that if well designed can deepen use of modern financial instruments.

Figure 4.1: Summary - key success factors



Source: Author's compilation

Table 4.1: Review of selected market based interventions and social support programmes

| i) Agricultural and Climate Risk Enterprise (ACRE) Africa | |
|--|--|
| <i>Geographical and Sectoral Coverage</i> | The project was initiated by Syngenta Foundation for Sustainable Agriculture, dubbed “Kilimo salama” to cushion small scale farmers against risks of droughts, excess rainfall and livestock diseases. It later transitioned to Agricultural and Climate Risk Enterprise (ACRE) Africa in 2014, as a for profit social enterprise supporting insurance providers to include weather index-insurance in their product portfolio. The programme covers Kenya, Tanzania and Rwanda. |
| <i>Project design</i> | It commenced in 2009 in Kenya with a pilot project in Laikipia offering index insurance to 200 farmers. Solar-powered weather stations gather weather data daily, and at end of each season the data is compared with historical weather data and insurance pay-out, if applicable, is sent via mobile phone to farmers. The programme insures farm inputs as opposed to farm outputs. |
| <i>Key partners and roles</i> | ACRE Africa undertakes product development, coordination of partners, and technical support. Safaricom provides communication networks for product sales and customer communication. The m-pesa mobile banking system helps keep administration costs low as farmers receive their index insurance policy numbers and premium receipts via SMS, and pay-outs electronically via M-Pesa. Insurance companies (UAP Old Mutual, CIC Insurance Group, APA Insurance, Heritage Insurance, UAP Insurance Tanzania, SORAS Insurance Rwanda) document insurance policy and carries risk (receive premiums and make pay-outs). Reinsurers do pricing policy and reinsures risk. Farmer aggregators (e.g. farmer organisations) and agrovets serve as channels for reaching farmers. Kenya Meteorological Department provides weather information. |
| <i>Achievements</i> | As of 2018 about 1.7 million farmers were cumulatively covered in the three East African countries – Kenya, Tanzania and Rwanda. Lower administrative costs as an alternative to indemnity-based insurance which would require actual visits by insurance company upon reporting by the farmer of the damage that has occurred. |
| <i>Challenges</i> | Low affordability in the absence of subsidies Underdeveloped distribution channels that fits farmer needs Few automated weather stations that can monitor the local weather patterns Low literacy levels and trust of insurance providers on the part of the farmers |
| <i>Sources consulted:</i> | ACRE Africa (2018); Greatrex et al (2015) |

| | |
|---|--|
| ii) Boma Project | <p>The Boma Project is a nonprofit NGO that uses a transformative approach to alleviate poverty and build resilience to climate change in Northern Kenya, covering Marsabit and Samburu Counties.</p> <p>The project uses Rural Entrepreneur Access Project (REAP) approach anchored on entrepreneurship support for women with the aim of graduating them from extreme poverty. The REAP aims to diversify income sources for women, with expectations that they can meet socio-economic needs such as healthcare, education and savings accumulation to cope with climate variability. Key features of the program include conditional cash transfer, financial and life skills training, mentoring and coaching, savings opportunities and access to finance and market linkages. It leverages on technology to provide real time information on programme activities for monitoring, feedback, and decision-making. E.g. The technological platform can track performance of savings groups and monitor performance of mentors in the field.</p> <p>BOMA Project implements the REAP programme and serve as a link with other partners, including resource mobilisation Research institutions (e.g. the University of California Davis, and ILRI) conduct research to assess programme design and impacts</p> <p>Kenyan government (National and county governments). Initiatives are underway to streamline the REAP model into the government social support programmes. Piloting was done in 2017 in Samburu County to assess its viability.</p> <p>Development partners and charity organisations/individuals contribute financial resources.</p> <p>Since commencement of the programme in 2009, about 22,915 women were enrolled in the REAP programme, 1,162 savings groups formed, and 7,805 businesses established by 2018. Other notable achievements include increase in household incomes, increase in household savings and generally women empowerment.</p> <p>Some of the challenges include low literacy levels; conflicts among group members; and cultural factors among local communities that limits women empowerment.</p> <p>Sources consulted: <i>BOMA Project (2019)</i>; and <i>Key Informant Interviews with BOMA offices in Marsabit and Samburu Counties</i></p> |
| iii) Index Based Livestock Insurance (IBLI) - International Livestock Research Institute | <p>IBLI is a donor-funded index-based insurance programme for designing and implementing market-mediated insurance products for pastoralists in Northern Kenya and Southern Ethiopia aimed at serving as drought safety net. It commenced with research and pilot phase in 2008-2010 in Marsabit. The programme covers six counties in Kenya: Marsabit, Samburu, Isiolo, Garissa, Wajir and Mandera. In Southern Ethiopia it covers the Borana region.</p> |

| | |
|---|--|
| <i>Project design</i> | ILRI led in design of the programme in collaboration with researchers from US universities (Cornell University; University of California, Davis; and Syracuse University). A twelve-month contract is sold in periods just preceding rainy seasons: January-February; and August-September; and the payout is triggered when the satellite measured forage availability falls below predetermined thresholds based on historical data (Johnson, Wandera, Jensen, & Banerjee, 2018). |
| <i>Key partners and roles</i> | Universities - Provide research on product design, implementation and impacts. Private sector (Financial institutions e.g. UAP Old Mutual, Takaful Insurance of Africa, APA Insurance, Equity Bank) - Product commercialization, implementation and popularization; participate in product development Development partners and donors (e.g. World Bank, European Union, DFID, Australia's Department of Foreign Affairs and Trade, World Vision) provide funding support. |
| <i>Achievements</i> | Scaling up and commercialization of index-based livestock insurance. An example is the Index-Based Takaful, rolled out by the Takaful Insurance of Africa in 2013 and as of 2019 operates in eight counties: Isiolo, Garissa, Mandera, Marsabit, Samburu, Wajir, Turkana and Tana River. Motivation of demand in other regional countries Research suggests households using IBLI have higher investments in livestock health services, increased livestock offtake during rainy seasons and thereby reducing distress sells, and demonstrate improved welfare due to reduced precautionary savings that are instead invested in productive opportunities |
| <i>Challenges</i> | Cultural and religious constraints e.g. demand for shariah compliant products by Muslim pastoral communities. There were also cultural factors that prohibited betting, which is viewed to be associated with insurance outcomes. Financial illiteracy - Poor understanding of how financial instruments such as insurance works limited uptake. Management of diverse stakeholder expectations e.g. private sector financial institutions were more aligned to profitable segments of the population, with households expecting social support. Marginal uptake (e.g. insuring few livestock), and limited geographical diversification constrain opportunities in risk pooling and diversification. |
| <i>Sources consulted:</i> | <i>Jensen et al (2017); Jensen and Barret (2017); (Jensen, Barrett, & Mude, 2017); Johnson et al (2018); (Technical Centre for Agricultural and Rural Cooperation, CTA, 2018); (Mathenge, Shibia, Olando, & Murithi, 2018)</i> |
| iv) Hunger Safety Net Programme (HSNP) - National Government | |
| <i>Geographical and Sectoral Coverage</i> | The programme is an unconditional cash transfer covering four arid counties in Northern Kenya: Turkana (39,918 households), Mandera (22,231 households), Marsabit (20,346 households) and Wajir (19,201 households), focusing on households living in extreme poverty and elderly persons (Oxford Policy Management, 2018). The programme is estimated to have disbursed KSh. 14.1 billion as of 2018, with 42 percent and 58 percent of the beneficiaries being male and female respectively (Oxford Policy Management, 2018). |

| | |
|---|---|
| <i>Project design</i> | <p>This is a donor funded national government programme that provides targeted participants with regular cash transfers. HSNP was implemented in two phases: Phase I - pilot phase covering 2008-2012; and Phase - II covering 2013-2017. The Programme is managed by the National Drought Management Authority (NDMA), which is mandated to coordinate all matters related to drought management. The beneficiary households represent 25 percent of the households in the four counties (Oxford Policy Management, 2018) and are registered with Equity Bank for direct transfer of cash (KSh. 5,100) every two months. Additionally, NDMA assesses weather conditions through satellite. If droughts become severe an additional 25 percent of the households receive a one-off emergency cash transfer, and in extreme conditions the coverage increases to 75 percent of the households in the four arid counties.</p> |
| <i>Key partners and roles</i> | <p>Government institutions – National government provides funding and implementation through NDMA. Chiefs and assistant chiefs support communication of the programme at the grassroots level.</p> <p>Donors and development partners (e.g. World Bank, UK Department for International Development (DFID) and UNICEF) provide funding</p> <p>Private sectors institutions (e.g. Equity Bank) provides the platform for cash payments.</p> <p>NGOs e.g. HelpAge International works with local NGOs to advocate for the rights of HSNP communities.</p> |
| <i>Achievements</i> | <p>Over 100,000 households in the four counties receive regular cash transfers every two months, with the number increasing if drought condition worsens.</p> <p>The households can smoothen consumption and the cash transfers have spillover as it raises incomes in the local economy</p> <p>Impact on long-term sustainable livelihoods and resilience to climate shocks is limited.</p> |
| <i>Challenges</i> | |
| <i>Sources consulted: Jensen et al (2017); Oxford Policy Management (2018).</i> | |
| v) Kenya Livestock Insurance Program (KLIP) – National Government of Kenya | |
| <i>Geographical and Sectoral Coverage</i> | <p>KLIP is a scale-up of IBLI and is partially subsidised by the national government. The program was launched in 2015, starting with Turkana and Wajir Counties in 2016 and later expanded to six other counties: Marsabit, Mandera, Garissa, Isiolo, Samburu and Tana River counties.</p> |
| <i>Project design</i> | <p>The program is limited to insuring five tropical livestock units - equivalent to five cattle or 50 goats and sheep per vulnerable household in the six counties. The program is a public-private sector partnership that brings together the government through the Ministry of Agriculture, Livestock, Fisheries and cooperatives; development partners (the World Bank and the International Livestock Research Institute); and private insurance providers: APA, Swiss Re, UAP-Old Mutual, CIC, Heritage, Jubilee, Kenya Orient and AMACO insurance companies. The program is based on the Index Based Livestock Insurance (IBLI) developed by ILRI. Insurance payments are based on forage availability as measured by satellite data that generates index of forage cover. Insurance payments are triggered once the forage cover falls below some critical level.</p> |

| | |
|---|---|
| <i>Key partners and roles</i> | <p>Government - Pays premium on behalf of the livestock keepers (for subsidized portion) and manages the roll out process including procuring of insurance providers;</p> <p>Development partners (e.g. World Bank, German Development Cooperation) - Provides funding, technical support and capacity building;</p> <p>Research institutions - ILRI provides technical support;</p> <p>Private sector (Insurance and Reinsurance companies) - Markets the insurance products and pay claims to the insured beneficiaries.</p> |
| <i>Achievements</i> | <p>In 2016/2017 about 14,000 households were covered for a total premium of KSh. 164 million, with the insurance companies paying total claims of KSh. 534 million⁵. As of July 2018, the programme was benefiting about 18,000 households (covering 90,000 livestock units) and 32,000 pastoralist households had benefited from KSh. 700 million in claims payouts since launch of the programme.</p> |
| <i>Challenges</i> | <p>The government cover per household is limited to five tropical livestock units (TLUs) equivalent to five cattle or 50 goats and sheep. There are however plans to increase 50% subsidy (based commercial premiums) cover to 10 TLUs under the voluntary commercial component of KLIP. If a household has more cattle or shoats, they need to pay the premiums themselves. Funding is therefore one of the constraints.</p> <p>The program covers only eight counties. There are 23 more counties that have been profiled by the Kenyan government as ASALs and prone to drought shocks</p> <p>Low financial literacy on insurance and how KLIP works.</p> <p>Poor infrastructure in some regions increase costs to the insured households especially where there are no mobile networks and mobile money platforms.</p> <p>Weak structures to effectively graduate beneficially households from full subsidy of five TLUs to partial subsidy and eventually to voluntary commercial contracts.</p> |
| <i>Sources Consulted: Fisheries and Irrigation (2018)</i> | <p><i>Financial Protection Forum (2016); Ministry of Devolution and ASAL (2018); Ministry of Agriculture, Livestock, Fisheries and Irrigation (2018)</i></p> |

⁵ Financial Protection Forum documentary: <https://www.financialprotectionforum.org/files/documentary-kenya-livestock-insurance-program-klip>

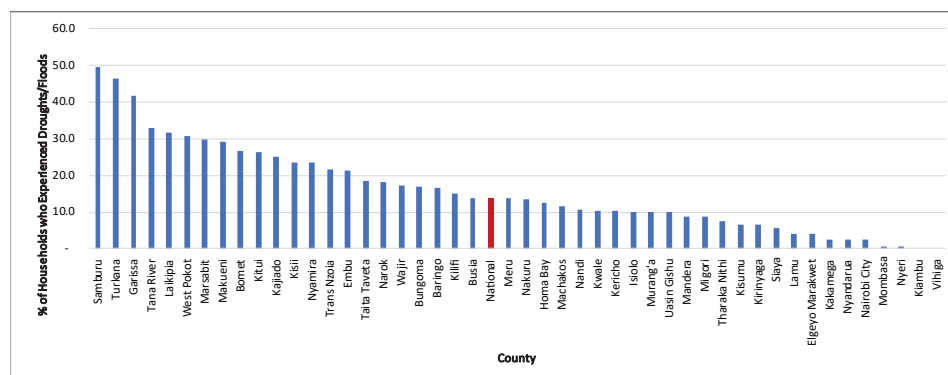
4.2 Household Coping Mechanisms

The analyses in this section are based on 2015/2016 KIHBS (KNBS, 2018a); and the 2018 KIPPRA Survey on Building Resilience to Mitigate the Impacts of Droughts and Floods in Kenya (KIPPRA, 2018). The descriptive statistics aims to address objective (2); in understanding various coping mechanisms used by households in mitigating the impacts of droughts and floods. Use of econometrics aims at quantifying factors determining different strands of coping mechanisms; broadly finance and non-finance that are further disaggregated into formal and informal coping mechanisms within each strand.

4.2.1 Descriptive Results

The 2015/2016 KIHBS shows that 27.3% of the households nationally reported to have been negatively affected by droughts or floods within five years preceding the survey. Among all the households in Kenya 13.7% ranked drought and floods to be the first severe shock; 14.2% ranked it to be the second severe shock and 12.2% rated it to be the third severe shock they experienced (KNBS, 2018b). Narrowing down to only the households who reported to be negatively affected by drought or floods, 49.6% indicated it to be the most severe shock they experienced; 32.0% reported it to be the second most severe shock and 18.4% indicated it to be the third most severe shock they experienced. County-level disaggregation in Figure 4.2 shows households that cited drought or floods as the first severe shock are mostly from Samburu, Turkana, Garissa, Tana River, Laikipia, West Pokot, Marsabit and Makueni counties; while those least affected are from Vihiga, Kiambu, Nyeri and Mombasa counties. The households mostly affected are therefore those residing in ASAL counties. These findings also suggest dominance of drought as a shock relative to floods. The 2015/2016 KIHBS did not separate responses for droughts and floods, which would have created additional insights in terms of their respective shocks separately by county. Perhaps this is an issue for consideration in future surveys.

With regards to the first coping mechanism employed by households, 30.4% of the respondents nationally reported to have taken no action as a response/ coping measure. At national level 21.5% of the households reported to employ finance coping mechanisms while 48.1% reported to employ non-finance coping mechanisms (Table 4.2). Households in non-ASAL and semi-arid regions tend to employ finance coping mechanisms as compared to households in arid areas.

Figure 4.2: Households reporting droughts/floods as the first severe shock by county

Data Source: (KNBS, 2018b)

At higher levels of aridity, more households tend to employ less of market-based finance coping mechanisms but instead largely rely on non-finance coping mechanisms that include measures such as reducing food consumption, migration, selling of assets and dependence on social transfers. The results in Table 4.2 also suggest that the proportion of households that took no coping measures first increases with levels of aridity, before falling and rising again. These findings perhaps suggest both severity of impacts of droughts and floods that triggers use of coping mechanisms, as well as scarcity of household resources at higher levels of aridity to invest in coping measures.

Table 4.2: Coping mechanisms in ASALs and non-ASALs (% of households)

| County Characteristics | Finance Coping | Non-finance Coping | Took No Action |
|--------------------------------|----------------|--------------------|----------------|
| Non-ASAL | 20.95 | 51.04 | 28.01 |
| Semi-arid: 10-29% aridity | 21.53 | 26.40 | 52.06 |
| Semi-arid: 30-84% aridity | 26.18 | 51.46 | 22.36 |
| Arid: 85-100% aridity | 9.06 | 62.30 | 28.64 |
| All counties (National) | 21.5 | 48.1 | 30.4 |

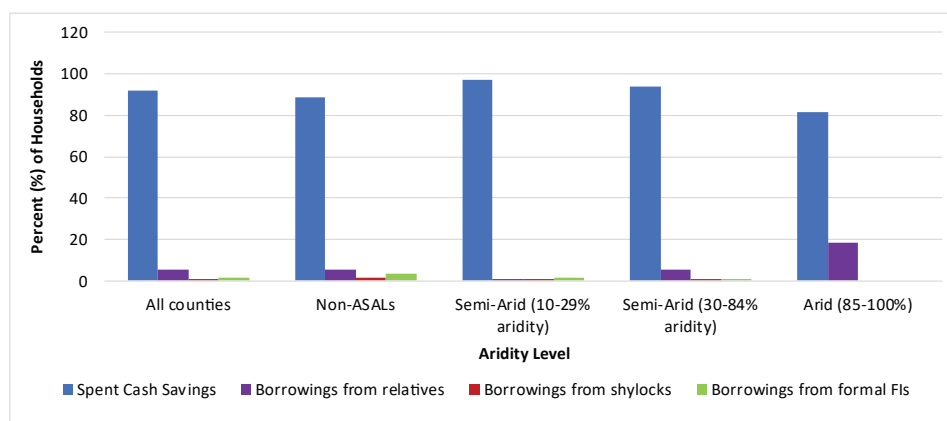
Data Source: (KNBS, 2018a)

4.2.1.1 Finance Coping Mechanisms

i) Finance Use Dynamics

Among the households that reported to use finance (21.5% of households surveyed) as the first coping mechanisms, 92.2% reported to use cash savings⁶, 5.4% reported to use borrowings from relatives, 0.7% borrowings from shylocks and 1.7% borrowings from formal financial institutions such as banks. The use of cash savings is dominant among the households in semi-arid counties (10-84% aridity) compared to arid counties (85-100% aridity) and non-ASAL counties. The households in arid counties demonstrate constrained use of formal financial instruments as they dominantly rely on borrowings from social networks such as relatives, friends and own savings. As evident from Figure 4.3 there is a declining use of formal financial instruments as aridity level of the county increases. The fact that households in arid counties demonstrate lower use of both cash savings and formal credit may suggest the acute nature of resource constraints they face. The 2018 KIPPRA survey shows a similar pattern of decreasing use of formal financial instruments and increasing use of informal financial instruments as county aridity level increases. The use of formal financial instruments among the surveyed households first increases with county aridity levels, then declines beyond some points: For Non-ASALs 13.6% of households reported to use formal financial instruments; for counties that experience 10-29% aridity, 33.9% of the households reported to use formal financial instruments; for 30-84% aridity 28.0% of households and for 85-100% aridity 14.9% of households use formal financial instruments.

Figure 4.3: Use of different finance coping mechanisms as the first priority

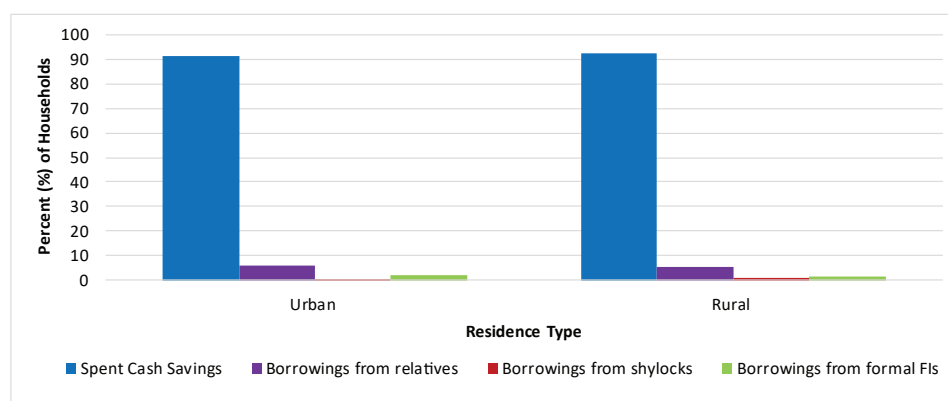


Data Source: (KNBS, 2018a)

⁶ With regards to coping mechanisms, the KIHBS survey did not distinguish between savings with formal financial institutions and informal savings outside formal financial services

Regarding the rural-urban divide (Figure 4.4), usage of own savings and borrowings from informal and formal sources demonstrate similar patterns. Among the households that reported to use finance as a first coping measure, the usage of savings among the urban and rural households was 91.5% and 92.4%, respectively. Borrowings from relatives accounted for 6.2% among the urban households and 5.3% among the rural households. Borrowings from formal financial institutions for urban and rural households were 1.8% and 1.6%, respectively. The dominance of savings as the main financial coping measure underscores not only the importance of promoting saving culture and deepen platforms that facilitate savings but also explore options for deepening alternative financial coping instruments such as insurance that tend to diversify risks.

Figure 4.4: Rural vs urban usage of financial instruments as coping measures



Data Source: (KNBS, 2018a)

The 2018 KIPPRA survey explored a range of formal and informal financial services that households usually employ to cope with the impacts of droughts and floods. About 87% of the households surveyed reported to use one or more financial instruments, but there is a dominance of informal financial coping mechanisms such as borrowings from social networks and saving with or borrowing from informal groups such as ROSCAs. About 12.7% of the surveyed households reported to use formal financial instruments such as saving with or borrowing from banks and SACCOs; insurance contracts and investment in or selling of capital markets instruments such as bonds and stocks. A larger proportion, 74% of the surveyed households reported to use a range of informal financial arrangements such as transfers from social networks (e.g. families/friends); saving with and borrowing from *chamas* (informal groups), ROSCAs; and borrowing from shylocks. There are however some variations with regards to the gender of the household head. For female-headed households 14.6% of the households use formal financial products,

70.0% use informal finance and 15.4% use neither formal nor informal finance as a coping mechanism to mitigate impacts of droughts and floods. For male-headed households 12.1% use formal finance, 75.1% use informal finance and 12.8% use neither formal nor informal finance as a coping mechanisms to mitigate impacts of droughts and floods. With regards to the rural-urban divide there is a 10.6 percentage point differences in the use of formal financial instruments as a coping measure: About 7.6% of the rural households reported to use formal financial instruments compared to 18.2% of the households in urban clusters.

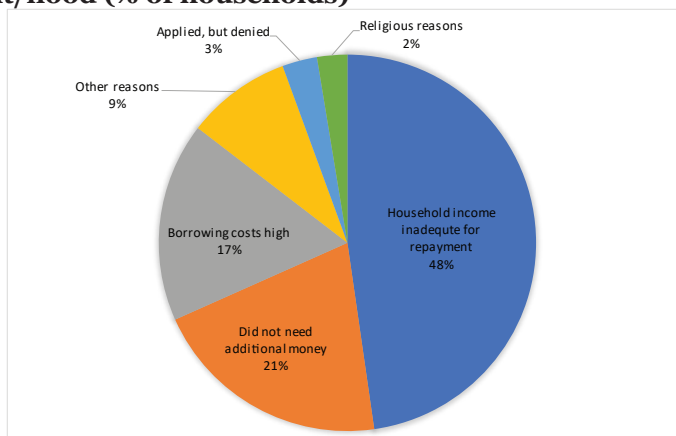
ii) *Constraints to Usage of Financial Instruments as a Coping Mechanism*

The 2018 KIPPRA survey sought to explore constraints to the use of financial instruments as a coping mechanism to mitigate impacts of drought and floods. This subsection presents the findings on these constraints with regards to borrowings, insurance and savings.

a) *Borrowing Constraints*

While borrowings prior to shocks (e.g. for alternative investment purposes) constitute *income smoothing* measure, borrowings after the shocks occur constitute *consumption smoothing* measure (Morduch, 1995) unless it is a line of credit contingent on drought or flood shocks. The 2018 KIPPRA Survey shows the main reasons reported for not borrowing to manage impacts of droughts and floods largely relate to low household income to support repayments and high costs of borrowings (Figure 4.5). About 21% of the households surveyed reported they did not need additional money to cope with droughts or floods. Conceptually, the low household income and lack of need for additional money are demand related constraints while the cost of borrowing reflects supply side constraints.

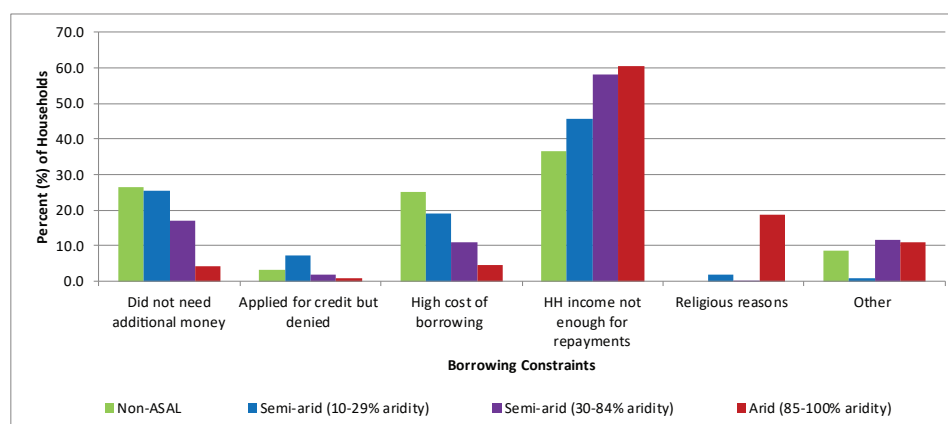
Figure 4.5: Household borrowings constraints during most recent last drought/flood (% of households)



Data Source: (KIPPRA, 2018)

Disaggregation of the borrowing constraints shows some disparities across different agro-climatic zones. As evident from Figure 4.6, the constraints relating to lack of need for additional money, high cost of borrowing and low household income demonstrate some novel patterns. While the constraints relating to lack of need for additional money and high cost of borrowing decreases with aridity levels, the reverse is true for the insufficiency of the household income to support repayments. These findings imply that while the households in the counties with high levels of aridity require credit to manage impact of droughts and floods, they are constrained by their weak repayment capabilities. Overcoming such constraints would therefore require addressing income deficiencies and/or design of credit instruments to meet their unique circumstances.

Figure 4.6: Borrowing constraints across different agro-climatic zones

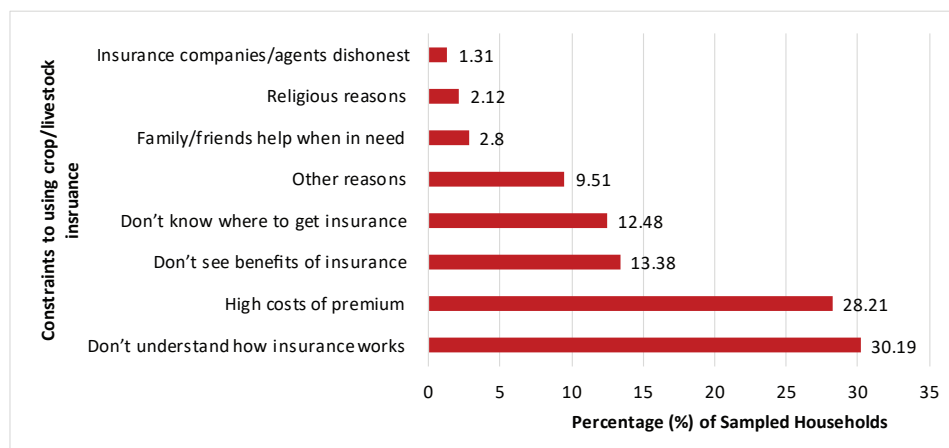


Data Source: (KIPPRA, 2018)

b) Uptake of Weather-Related Insurance

Uses of insurance products constitute ex-ante coping measures as the decision for taking insurance is generally made prior to the occurrence of shocks. The proportion of households surveyed that reported to have any form of insurance was 13.91%. Majority of these were however health related insurance (including NHIF), which reflects the recent government initiatives to deepen uptake of NHIF for persons working in the informal sector, as well as the elderly persons. Those who reported to have crop insurance were 0.7%, while those with livestock insurance were negligible. As shown in Figure 4.7, low financial literacy, high costs of premiums and disinterest due to perceived low benefits of insurance are the main constraints that impede the sampled households from taking crop and livestock insurance. These constraints mirror findings of the 2019 FinAccess Household Survey (FinAccess, 2019a) that reveal similar challenges.

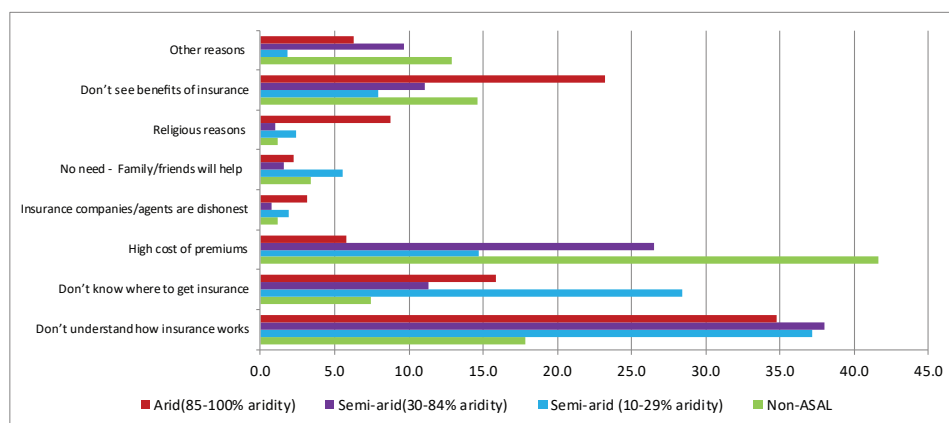
Figure 4.7: Constraints to uptake of livestock and crop insurance



Data Source: (KIPPRA, 2018)

Further disaggregation of the constraints by agro-climatic zones show that for households residing in non-ASAL counties, the main constraints related to livestock and crop insurance are high costs of premium, low financial literacy and the perceived lack of benefits accruing from insurance uptake (Figure 4.8). For households residing in ASAL counties the main constraints reported by the sampled households relate to low financial literacy, inaccessibility to insurance providers and perceived lack of benefits from taking insurance.

Figure 4.8: Insurance constraints (% of sampled households) across different agro-climatic zones



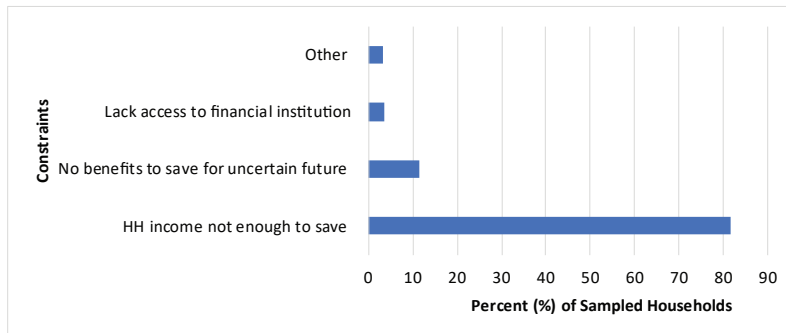
Data Source: (KIPPRA, 2018)

c) Uptake of Weather Savings Instruments

Precautionary savings constitute ex-ante measures but have embedded implicit cost in foregone investment opportunities that may otherwise yield better future

returns. The extent of the implicit costs of precautionary savings may depend on availability of short-term investments that can be liquidated when needed, as well as financial literacy of the household to optimally utilise such opportunities. The main reasons for lack of saving instruments among the sampled households was low household income, lack of incentives to save for uncertain future events and lack of access to financial institutions (Figure 4.9).

Figure 4.9: Constraints to the uptake of savings financial coping instruments

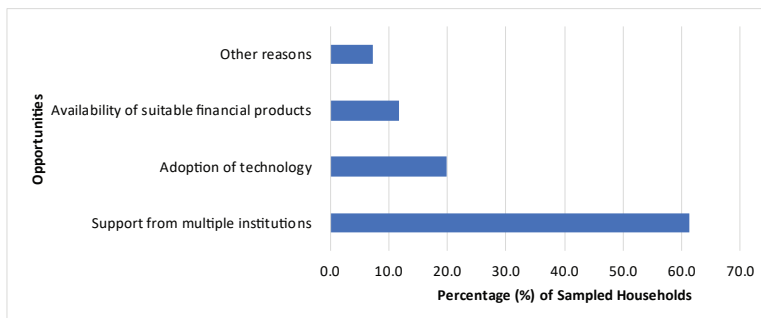


Data Source: (KIPPRA, 2018)

iii) Emerging Opportunities and Challenges in Use of Financial Instruments

Support from multiple institutions was identified as the main emerging opportunity in the use of financial instrument, followed by adoption of technology and availability of suitable financial products. These findings reflect increasing involvement of the government and nongovernment actors in the management of drought and floods due to growing policy concerns on the increasing frequency and severity of climate related hazards. The growth of mobile phones ownership with data capabilities (i.e. internet) and mobile money is perhaps one of the reasons adoptions of technology has been identified as an emerging opportunity.

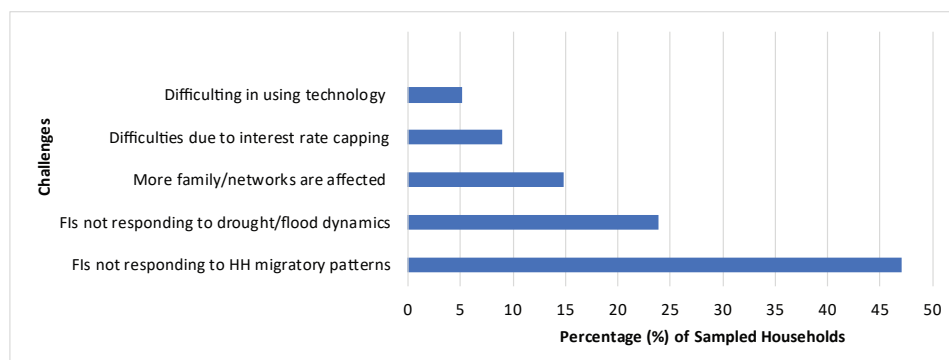
Figure 4.10: Emerging opportunities in the use of financial instrument as a coping measure



Data Source: (KIPPRA, 2018)

The emerging challenges identified by the sampled households (Figure 4.11) mainly relate to the mismatch between supply and demand characteristics of financial products and the covariate nature of the impacts of droughts and floods. The main emerging challenges identified include weak response of financial institutions to the migratory patterns of households and the weak response by financial institutions in responding to the drought and flood dynamics. The fact that more family and social network members are concurrently affected emerged as the third main emerging challenges. As more social networks are affected reliance on informal coping mechanisms such as intra-household or inter-household transfers would become less effective.

Figure 4.11: Emerging challenges in the use of financial instruments as a coping measure



Data Source: (KIPPRA, 2018)

The 2018 KIPPRA Survey elicited information from financial institutions and other actors supporting use of financial instruments. The feedback from key informant interviews with regards to uptake of financial products is summarized in Table 4.3. These are summarized in three thematic areas: Opportunities, challenges and proposed recommendations.

Table 4.3: Key informant interview summary**Key Opportunities**

- More households are realising climate change is a real threat, and this creates incentives for uptake of modern coping mechanisms such as livestock and crop insurance.
- Favourable regulatory reforms e.g. those related to takaful (Shariah compliant) insurance and index-based weather insurance.
- Kenya Vision 2030 flagship projects e.g. Isiolo international airport and the LAPPSET project that are envisaged to open opportunities for livestock market in ASALs – both domestic and international markets. Such projects are viewed as opportunities for market integrations and incentives that can support offtake of livestock to, for instance, minimise drought related losses.

Challenges

- Low financial literacy - Weak understanding of formal financial product features and workings. The problem is compounded by general illiteracy levels especially in rural areas and ASALs.
- Poor infrastructure (roads, electricity, communication) in rural areas hamper product marketing and financial services connectivity.
- Recurrent nature of droughts/floods that deplete household livelihoods over time, making them more vulnerable in the long term.
- Low trust in insurance providers stifle uptake and deepening of the product as a market-based coping measure.
- Weak linkages of financial institutions with government funds (e.g. Youth Fund) weakens market synergy.
- Weak knowledge on alternative livelihoods among the pastoral communities and cultural impediments to adoption of alternative livestock and crop varieties that would otherwise be more resilient.
- Insecurity in some ASAL areas create disincentives for investments, hence creating low supply of financial products.
- Fluctuations in household incomes increase uncertainty in ability to make loan repayments. Demand for credit is thus highly seasonal - mainly occurring during peak season of local economic activities.
- Capacity limitations on the part of financial service providers. For example, challenges in forecasting weather patterns, and development and implementation of weather-related index-based financial products.

Proposed Recommendations

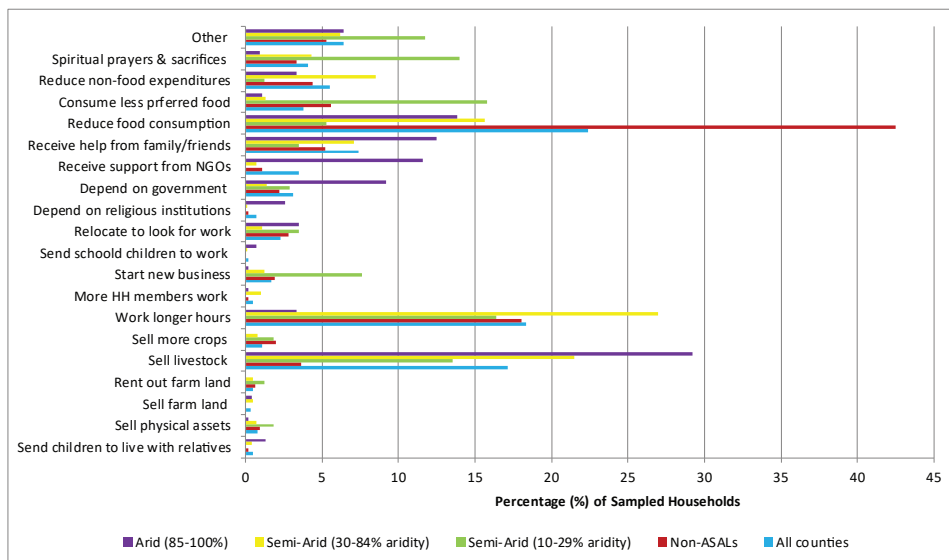
- Awareness creation on climate information and financial products by financial institutions, with support from government and development partners.
- Support scale-up of existing financial instruments interventions e.g. index-based livestock insurance.
- Infrastructure development e.g. refrigeration services/support.
- Market development e.g. access to market information, market infrastructure.
- Facilitate destocking of livestock at favourable prices. Attractive prices would act as incentives for destocking to avoid losses to droughts.
- Promote entrepreneurial culture among the pastoral communities who are disproportionately vulnerable to droughts.
- Enhance access to information e.g. alternative economic activities, opportunities provided by county governments, weather forecasts information.
- Encourage partnerships among various actors in providing financial products.
- Enhance security across the country - insecurity poses risks to operations of financial institutions e.g. accessibility of some areas, loan repayments capability etc.

Source - Key Informant Interviews (See Annex 5)

4.2.1.1 Non-Finance Coping Mechanisms

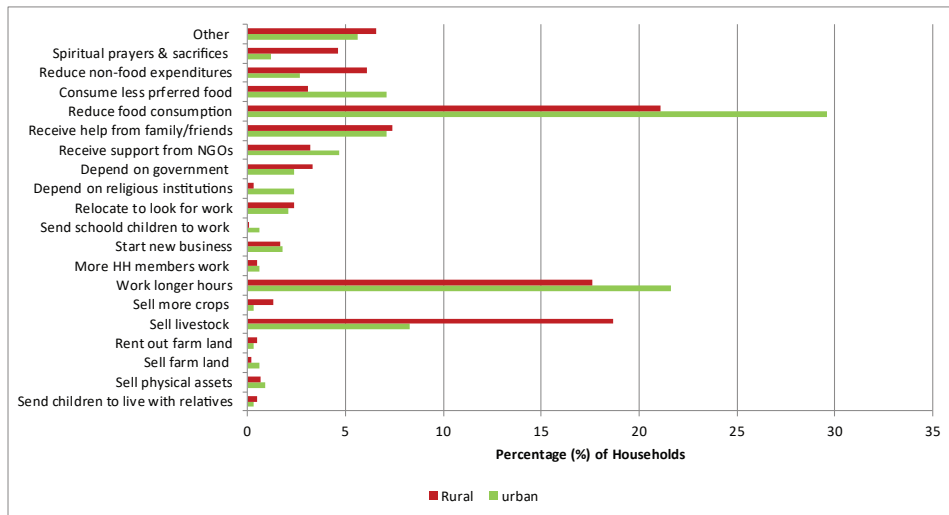
Non-finance coping mechanisms across different agro-climatic zones are illustrated in Figure 4.12. The main non-finance coping mechanisms employed are reduced food consumption, sell of livestock and extended working hours. Other mechanisms that are used to a moderate extent include consumption of less preferred food, spiritual prayers and sacrifices and dependence on government and NGO support. Among the non-ASAL counties reduced food consumption and working for longer hours are the main non-financial coping mechanisms. In ASAL counties households largely depend on sell of livestock, working for longer hours, consumption of less preferred food and turning to spiritual prayers or sacrifices.

Figure 4.12: Non-finance coping measures across agro-climatic zones



Data Source: (KNBS, 2018a)

With regards to the urban vs. rural dynamics (Figure 4.13), the main non-finance coping mechanisms among the urban households are reduced food consumption, extended working hours, and to some extent sell of livestock, support from family/friends and consumption of less preferred food.

Figure 4.13: Non-finance coping measures: Rural vs urban households

Data Source: (KNBS, 2018a)

4.2.2 Econometric Results

4.2.2.1 Choice of Coping Measures

This section employs econometric analysis to gain insights into the drivers of choices households make in coping with the impacts of droughts and floods. Ideally households may use a coping mechanism in isolation or use it jointly with other coping mechanisms, whether formal or informal. Some households may not employ coping mechanisms of any kind; hence they remain excluded and remain highly susceptible to the impacts of drought and floods. In this paper coping mechanisms are broadly thought of as comprising of finance and non-finance measures, which are further subclassified into formal and informal measures following the conceptualization of the coping mechanisms typology presented in Section 3.2.

Using the typology and weighted estimates Table 4.4 typifies coping mechanisms

employed by the households ranging from no coping mechanism to use of formal finance and formal non-finance coping mechanisms. These results are based on the KIPPRA 2018 Survey. The groupings of these coping mechanisms are elaborated in Annex 4 following the conceptualisation in Section 3.2. About 10% of the sampled households reported to employ neither finance nor non-finance coping mechanisms to manage the impacts of droughts and floods. About 58% of the households reported to employ only informal coping mechanisms with 32% reporting to use formal coping mechanisms to manage the risks posed by droughts and floods. Disaggregating the coping mechanisms into *droughts only* and *floods only*, it is evident that floods is of lesser constraints as 47% of the households reported to have taken no coping mechanism compared to 18% for droughts.

Table 4.4: Coping measures to manage impacts of droughts and floods

| Category of Coping mechanisms | Percent (%) of Households | | | Coping Strand Classification |
|---|---------------------------|--------------|-------------|------------------------------|
| | Drought & floods | Drought Only | Floods Only | |
| i) No coping mechanism | 10.2 | 17.6 | 46.5 | No coping measure |
| ii) Use at most one category of informal coping: finance or non-finance | 3.4 | 5.3 | 22.1 | Informal coping mechanisms |
| iii) Use informal finance and informal non-finance | 54.2 | 43.2 | 8.9 | |
| iv) Formal finance or formal non-finance coping and informal finance or informal non-finance coping | 32.0 | 33.3 | 22.3 | Formal coping mechanisms |
| v) Use formal finance and formal non-finance | 0.3 | 0.6 | 0.1 | |

Data Source: (KIPPRA, 2018)

Bivariate Probit Model (elaborated in Section 3.3) was employed to understand the usage of the different coping strategies employed by the sampled households. First, the analyses focus on finance and nonfinance coping mechanisms - combining droughts and floods, then droughts only and finally floods only. Second, the analyses narrow to finance coping mechanism, exploring use of formal finance and informal finance. Finally, the analyses focus on use of non-finance coping mechanisms, digging deeper into the use of formal non-finance and informal-non-finance coping mechanisms.

i) Determinants of Droughts and Floods Coping Mechanisms

a) *Use of Finance and Non-Finance Coping Mechanisms*

The correlation among the use of finance and non-finance coping mechanisms, ρ , is positive (0.9605461) and statistically significant ($Prob > \chi^2 = 0.0000$) at 5% significance level. This confirms suitability of the bivariate Probit model. The positive coefficient suggests complementarities among the use of finance and non-finance coping mechanisms. Focusing on the usage of neither finance nor non-finance coping measures $P(00)$ in Table 4.5a, the findings suggest that urban households, an additional household income earner, an additional year of formal education and residence in ASAL counties are associated with *lower* probabilities of *not* using any of the finance or non-finance coping mechanisms. Urban households, an additional household income earner and more years of formal education are usually associated with access to diverse range of resources and opportunities (Scoones, 1998; Barret & Constas, 2014), possibly allowing them to use one or more coping alternatives in terms of finance and non-finance coping mechanisms. For *non-finance coping mechanisms only*, $P(01)$, the findings suggest urban households (compared to rural households) and an additional year of formal education for the household head are associated with lower probability of using nonfinance coping mechanisms only. For *finance coping mechanisms only*, $P(10)$, households residing in counties classified as highly arid relative to non-ASAL tend to have lower probability of using finance coping mechanisms, which is plausible given difficulties in accessing financial services. Recent surveys of financial inclusion suggest these regional disparities in the usage of financial services (FinAccess, 2019a). With regards to the joint usage of finance and non-finance coping mechanisms, $P(11)$, urban households, an additional household income earner, an additional year of formal education of the household head and ASAL households relative to non-ASALs are associated with higher probabilities of usage. Households residing in ASAL counties have higher percentage point probabilities of jointly using finance and non-finance coping mechanisms compared to non-ASAL households given they are driven by incentives to cushion themselves especially from adverse impacts of droughts (Boka, 2017). As evident from the descriptive statistics, households residing in counties with higher levels of aridity majorly rely on nonfinance coping mechanisms and informal finance.

Table 4.5a: Bivariate probit marginal effects: Finance and non-finance coping mechanisms

| Variables | <i>P</i> (00) None of finance or nonfinance coping mechanisms | <i>P</i> (01) Nonfinance coping mechanisms only | <i>P</i> (10) Finance coping mechanisms only | <i>P</i> (11) Finance and nonfinance coping mechanisms |
|--------------------------------------|--|---|--|--|
| Cluster: Urban | -0.138*** (0.0256) | -0.0328*** (0.00745) | -0.0132 (0.00994) | 0.184*** (0.0315) |
| Household size | 0.00175 (0.00302) | 0.00167 (0.00154) | -0.000948 (0.00156) | -0.00247 (0.00444) |
| No. of household income earners | -0.0183** (0.00825) | -0.000134 (0.00494) | -0.00857* (0.00479) | 0.0270** (0.0119) |
| HH head years of formal education | -0.00440** (0.00184) | -0.00255*** (0.000815) | 0.000614 (0.000800) | 0.00634** (0.00266) |
| Age of household head | -0.000794 (0.00282) | 0.000399 (0.00133) | -0.000801 (0.00141) | 0.00120 (0.00411) |
| Square of age of household head | 1.16e-05 (2.57e-05) | -3.54e-06 (1.19e-05) | 9.25e-06 (1.27e-05) | -1.73e-05 (3.75e-05) |
| Gender of household head: Male | 0.00106 (0.0189) | -0.00440 (0.0102) | 0.00488 (0.00852) | -0.00155 (0.0276) |
| Semi-arid:10-29% aridity | -0.0959** (0.0394) | -0.00654 (0.00869) | -0.00716 (0.0144) | 0.110** (0.0454) |
| Semi-arid:30-84% aridity | -0.250*** (0.0293) | 0.0132 (0.00956) | -0.0474*** (0.00977) | 0.284*** (0.0319) |
| Arid:85-100% aridity | -0.258*** (0.0289) | -0.00562 (0.00888) | -0.0474*** (0.00981) | 0.311*** (0.0315) |
| Observations | 1,324 | 1,324 | 1,324 | 1,324 |

Data Source: (KIPPRA, 2018)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

b) Use of Formal Finance and Informal Finance Coping Mechanisms

The correlation among the two choices, ρ , is negative (-0.3264481) and statistically significant ($Prob > \chi^2 = 0.0000$) at 5% significance level. This confirms suitability of the bivariate Probit model. The negative coefficient on ρ suggests substitutability among the use of formal finance and informal finance for coping with droughts and floods. With regards to the use of informal finance only, $P(01)$, an additional household income earner is associated with lower probabilities of informal finance usage. This suggests lower usage of informal finance among the households with higher incomes, in congruence with recent financial inclusion surveys (FinAccess, 2019a).

With regards to the use of formal finance only, $P(10)$, urban households have about 10 percentage points lower probability of using formal finance to cope with droughts and floods, compared to rural households. This might suggest that urban households engage less in economic activities that are disproportionately vulnerable to the impacts of droughts and floods. The other key variable is the county aridity classifications. Households that reside in ASAL counties with higher levels of aridity have lower probabilities of using formal finance as a coping mechanism compared to the households residing in non-ASAL counties. With regards to the usage of informal finance only the results largely contrast that of formal finance usage. Compared to non-ASAL residing households, households residing in ASAL counties with higher levels of aridity demonstrate higher probabilities of using informal finance to cope with the impacts of droughts and floods. Urban households have a higher probability of jointly using formal finance and informal finance compared to rural households $P(11)$. Similarly, male-headed households have a higher probability of jointly using formal finance and informal finance to cope with droughts and floods.

Table 4.5b: Bivariate probit marginal effects: Formal finance and informal finance

| Variables | $P(00)$ None of formal finance or informal finance | $P(01)$ Informal finance only | $P(10)$ Formal finance only | $P(11)$ Formal finance and informal finance |
|-----------------------------------|---|-------------------------------------|-----------------------------------|---|
| Cluster: Urban | -0.0411*** (0.0103) | -0.0248 (0.0386) | -0.0986*** (0.0324) | 0.164*** (0.0413) |
| Household size | -0.00291 (0.00200) | 0.00214 (0.00728) | -0.00811 (0.00603) | 0.00887 (0.00788) |
| No. of household income earners | 0.00181 (0.00438) | -0.0374** (0.0172) | 0.0215* (0.0128) | 0.0141 (0.0183) |
| HH head years of formal education | -0.00162 (0.00109) | -0.00454 (0.00413) | -0.00191 (0.00304) | 0.00807* (0.00450) |
| Age of household head | -0.000466 (0.00153) | 0.00606 (0.00677) | -0.00391 (0.00462) | -0.00168 (0.00676) |
| Square of age of household head | 4.80e-06 (1.36e-05) | -5.67e-05 (6.34e-05) | 3.76e-05 (4.15e-05) | 1.42e-05 (6.18e-05) |
| Gender of household head: Male | -0.0258* (0.0137) | -0.0423 (0.0501) | -0.0355 (0.0327) | 0.104** (0.0478) |
| Semi-arid:10-29% aridity | -0.00738 (0.0193) | 0.375*** (0.0620) | -0.244*** (0.0483) | -0.124** (0.0615) |
| Semi-arid:30-84% aridity | -0.0327** (0.0129) | 0.388*** (0.0458) | -0.273*** (0.0452) | -0.0818* (0.0495) |

| | | | | |
|----------------------|------------------------|----------------------|-----------------------|---------------------|
| Arid:85-100% aridity | -0.0362*** (0.0140) | 0.356*** (0.0596) | -0.274*** (0.0459) | -0.0453 (0.0645) |
| Observations | 1,106 | 1,106 | 1,106 | 1,106 |

Data Source: (KIPPRA, 2018)

Standard errors in parentheses

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*

c) Use of Formal Non-finance and Informal Non-Finance Coping Mechanisms

The correlation ρ , among the use of formal non-finance and informal non-finance is negative (-0.6664678) and statistically significant ($Prob > \chi^2 = 0.0009$) at 5% significance level. This confirms suitability of the bivariate Probit model. The negative coefficient on ρ suggests substitutability among the use of formal non-finance and informal non-finance measures for coping with the impacts of droughts and floods. For informal non-finance coping only $P(01)$, urban households have lower probability of usage compared to rural households. Similarly, households residing in ASAL counties characterised as having higher aridity levels demonstrate lower usage of informal non-finance coping measures compared to non-ASAL households.

Urban households have higher probability of using formal non-finance coping mechanisms compared to rural households $P(10)$. ASAL-residing households have higher probabilities of using formal non-finance coping measures compared to non-ASAL households. This is likely to be the result of government interventions in ASAL counties through social support systems. An additional income earner is associated with lower probability of using formal non-finance coping measures. This perhaps is driven by the fact that public interventions such as social support system and subsidies tend to benefit poorer households. For the joint usage of formal non-finance and informal non-finance coping measures $P(11)$, the key driving factors include urban residence and county aridity. Urban households have higher probability of jointly using formal non-finance and informal non-finance coping measures compared to rural households. Similarly, ASAL-households demonstrate higher probability of jointly using formal non-finance and informal non-finance coping measures compared to non-ASAL households.

Table 4.5c: Bivariate probit marginal effects: Formal non-finance and informal non-finance

| Variables | <i>P</i> (00) None of formal non- finance or informal non-finance | <i>P</i> (01) Informal non-finance only | <i>P</i> (10) Formal non-finance Only | <i>P</i> (11) Formal non- finance and informal non-finance |
|-----------------------------------|--|--|--|---|
| Cluster: Urban | -0.0158* (0.00899) | -0.226*** (0.0345) | 0.127*** (0.0338) | 0.115*** (0.0442) |
| Household size | -0.000240 (0.000363) | -0.000396 (0.00613) | -0.00911 (0.00782) | 0.00975 (0.00974) |
| No. of household income earners | -0.000421 (0.000727) | 0.0220* (0.0119) | -0.0624*** (0.0213) | 0.0409* (0.0238) |
| HH head years of formal education | -7.28e-05 (0.000213) | -0.00325 (0.00358) | 0.00364 (0.00359) | -0.000315 (0.00536) |
| Age of household head | 0.000108 (0.000277) | 0.00276 (0.00472) | -0.00120 (0.00686) | -0.00167 (0.00814) |
| Square of age of household head | -1.70e-06 (2.80e-06) | -3.67e-05 (4.56e-05) | 4.60e-06 (6.29e-05) | 3.38e-05 (7.66e-05) |
| Gender of household head: Male | 0.00158 (0.00160) | 0.0125 (0.0280) | 0.0496 (0.0447) | -0.0636 (0.0504) |
| Semi-arid:10-29% aridity | -0.0189* (0.0102) | -0.467*** (0.0362) | 0.302*** (0.0639) | 0.183*** (0.0673) |
| Semi-arid:30-84% aridity | -0.0189* (0.0102) | -0.470*** (0.0357) | 0.169*** (0.0400) | 0.320*** (0.0451) |
| Arid:85-100% aridity | -0.0189* (0.0102) | -0.470*** (0.0357) | 0.142*** (0.0509) | 0.347*** (0.0557) |
| Observations | 1,101 | 1,101 | 1,101 | 1,101 |

Data Source: (KIPPR, 2018)

Standard errors in parentheses

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*

ii) Determinants of Droughts Only Coping Mechanisms

The analysis in this section focuses on how households cope with the impacts of droughts only. The correlation, ρ_s for the bivariate Probit model was found to be insignificant for the joint usage of finance and non-finance; as well as for the joint usage of formal finance and informal finance. This means the use of bivariate Probit model is inappropriate and univariate Probit model should be used instead. For the usage of formal non-finance and informal non-finance the ρ is statistically significant and bivariate Probit model is therefore appropriate.

Table 4.6a provides marginal effects for the univariate Probit for use of finance (formal and informal combined); formal finance only; informal finance only; and non-finance coping mechanisms. For the combined usage of formal and informal finance (column (a) in Table 4.6a), key driving factors are years of formal education for the household head, age of the household head, and gender of the household head. An additional year of formal education is associated with a higher probability of using finance as a coping mechanism, though this was found statistically significant at 10%. The effects of an additional age of the household head is initially positively associated with usage of finance but at much older age (as proxied by the age squared term), the effects become negative. This is in congruence with the life cycle theory (Modigliani & Brumberg, 1954; Modigliani & Brumberg, 1980) which postulate that financial behaviour of individuals vary over the life cycle, and as such individuals' saving rates increases during working years but decreases and may even become negative in retirement as income diminishes. Male-headed households tend to have higher usage of finance as a coping mechanism compared to female-headed households. The marginal effects suggest that male-headed households have about 7.8 percentage points higher probability of using finance as a coping mechanism compared to female-headed households. This could be driven by institutional factors such as gender relations that tend to favour male individuals in access to resources in developing countries (Johnson, 2004; Aterido, Beck, & Iacovone, 2013).

Turning the focus to the use of *formal finance only* (column (b)), the key drivers include urban residence, household income, and years of formal education of the household head; which all tend to increase the usage of formal finance as a coping mechanism to mitigate impacts of droughts. These findings reflect the general trends in the overall usage of financial services in Kenya, with disproportionately higher proportion of usage among urban households, the wealthy households and those with more years of formal education (FinAccess, 2019a). For *informal finance only*, the key driving factor relate to age of the household head, which initially tend to have positive effects but at much older age turns out to be negative. Urban households, an additional year of formal education for the household head and residence in ASAL counties tend to increase the probability of usage of *non-finance coping mechanisms*.

Table 4.6a: Probit marginal effects: Finance, non-finance, formal finance and informal finance coping mechanisms

| Variables | (a) Finance coping (formal and informal finance) | (b) Formal finance coping | (c) Informal finance coping | (d) Non-finance coping |
|-----------------------------------|--|------------------------------|--------------------------------|---------------------------|
| Cluster: Urban | -0.00337 (0.0191) | 0.126*** (0.0420) | 0.00805 (0.0270) | 0.162*** (0.0351) |
| Household size | -0.00398 (0.00408) | -0.0158* (0.00890) | 0.00448 (0.00806) | -0.00333 (0.00591) |
| No. of household income earners | 0.0109 (0.0141) | 0.0414** (0.0202) | 0.00624 (0.0169) | 0.00386 (0.0154) |
| HH head years of formal education | 0.00334* (0.00189) | 0.0269*** (0.00423) | -0.00198 (0.00321) | 0.00939** (0.00371) |
| Age of household head | 0.0103** (0.00399) | 0.00630 (0.00754) | 0.0129** (0.00521) | -0.00282 (0.00527) |
| Square of age of household head | -9.76e-05*** (3.58e-05) | -4.48e-05 (7.23e-05) | -0.000129*** (4.73e-05) | 2.91e-05 (4.99e-05) |
| Gender of household head: Male | 0.0780*** (0.0300) | 0.0544 (0.0548) | 0.0578 (0.0375) | -0.0108 (0.0335) |
| Semi-arid:10-29% aridity | -0.00565 (0.0356) | 0.0657 (0.0697) | -0.0173 (0.0525) | 0.293*** (0.0462) |
| Semi-arid:30-84% aridity | 0.00702 (0.0285) | 0.00912 (0.0584) | 0.0366 (0.0412) | 0.491*** (0.0313) |
| Arid:85-100% aridity | 0.0223 (0.0342) | -0.0777 (0.0651) | 0.0296 (0.0477) | 0.494*** (0.0316) |
| Observations | 1,082 | 1,053 | 1,061 | 1,324 |

Data Source: (KIPPRA, 2018)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The usage of formal non-finance and informal non-finance for coping with *droughts only* is analysed using bivariate Probit model. As noted earlier with regards to the usage of formal non-finance and informal non-finance the correlation, ρ is statistically significant ($Prob > \chi^2 = 0.0002$) and bivariate Probit model is therefore appropriate. The bivariate Probit model marginal effects are provided in Figure Table 4.6b. The positive coefficient for ρ (0.3233816) is evidence of the complementarity in the usage of formal non-finance coping mechanisms and informal non-finance coping mechanisms for mitigating the impacts of droughts. Urban households, an additional year of formal education and ASAL-residence are associated with lower probability of not employing any of formal non-finance or informal non-financing coping measures $P(00)$. Urban

households and ASAL residing households are associated with lower probability of using informal non-finance $P(01)$ compared to rural households and non-ASAL households, respectively. Urban households as well as ASAL residing households are associated with higher probability of using formal non-finance while an additional household income earner is associated with lower probability of its usage $P(10)$. An additional year of formal education of the household head and being ASAL households are associated with higher probability of jointly using formal non-finance and informal non-finance $P(11)$.

Table 4.6b: Bivariate probit marginal effects: Formal non-finance and informal non-finance

| Variables | $P(00)$ None of formal non- finance or informal non-finance | $P(01)$ Informal non-finance only | $P(10)$ Formal non- finance only | $P(11)$ Formal non- finance and informal non-finance |
|--------------------------------------|--|--|--|--|
| Cluster: Urban | -0.0748*** (0.0244) | -0.0891*** (0.0182) | 0.210*** (0.0381) | -0.0466 (0.0389) |
| Household size | 0.00367 (0.00444) | 0.00196 (0.00248) | -0.00315 (0.00737) | -0.00247 (0.00761) |
| No. of household income earners | -0.0116 (0.0124) | 0.00654 (0.00493) | -0.0355** (0.0155) | 0.0405* (0.0218) |
| HH head years of formal education | -0.00846*** (0.00276) | -0.00204 (0.00156) | -0.00158 (0.00448) | 0.0121*** (0.00426) |
| Age of household head | 0.00308 (0.00369) | 0.00412 (0.00252) | -0.0115* (0.00676) | 0.00430 (0.00593) |
| Square of age of household head | -3.59e-05 (3.49e-05) | -4.00e-05* (2.37e-05) | 0.000105* (6.28e-05) | -2.93e-05 (5.47e-05) |
| Gender of household head: Male | 0.0241 (0.0256) | 0.00152 (0.0137) | 0.0218 (0.0429) | -0.0474 (0.0492) |
| Semi-arid:10-29% aridity | -0.144*** (0.0439) | -0.0840*** (0.0253) | 0.157*** (0.0477) | 0.0717 (0.0508) |
| Semi-arid:30-84% aridity | -0.295*** (0.0337) | -0.123*** (0.0229) | 0.0151 (0.0391) | 0.404*** (0.0416) |
| Arid:85-100% aridity | -0.310*** (0.0339) | -0.139*** (0.0231) | 0.0599 (0.0530) | 0.389*** (0.0553) |
| Observations | 1,227 | 1,227 | 1,227 | 1,227 |

Data Source: (KIPPR, 2018)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

The analyses also explored how access to climate information affect choice of coping mechanisms. For brevity the full results are not displayed here, but for the bivariate Probit regressions in which the information access variable marginal effects are statistically significant are displayed in Annex 6a and 6b. The results are shown for determinants of coping mechanisms for non-finance (formal non-finance and informal non-finance) usage and the broad strands of finance and non-finance usage for coping with droughts. An information access index was constructed from the respondents' responses on whether they have access to modern media (radio/Tv; newspapers; NDMA; websites such as those of the Kenya Meteorological Department; and SMS alerts) for accessing weather information including temperature, rainfall, droughts and floods. For each of the five channels/media, a score of 1 is given if the respondent indicated to access the weather information through it. For each of the channel/media that the respondents indicated not to have access to weather information, a score of 0 was awarded. For non-finance usage the correlation, ρ was negative (-0.7320591) and statistically significant ($Prob > chi^2 = 0.0071$) indicating substitutability of formal non-finance and informal non-finance coping mechanisms. For finance and non-finance usage, the coefficient on ρ was positive (0.9672237) and statistically significant ($Prob > chi^2 = 0.0000$) indicating complementarity of finance and non-finance coping mechanisms. The results suggest that a marginal increase in weather information access index is associated with higher probability of jointly using formal non-finance and informal non-finance coping mechanisms (Annex 6a). The results also suggest that a marginal increase in weather information access index is associated with a higher probability of jointly using finance and non-finance coping mechanisms in a complementary way (Annex 6b). These results have important policy implications in that access to climate information through modern technologies is essential for supporting household responses to climate-induced risks resulting from droughts.

iii) Determinants of Floods Only Coping Mechanisms

a) Use of Finance and Non-Finance Coping Mechanisms

The correlation ρ , among the use of finance and non-finance coping mechanisms is positive (0.8816113) and statistically significant ($Prob > chi^2 = 0.0000$) at 5% significance level. This confirms suitability of the Bivariate Probit model. The positive coefficient on ρ suggests complementarity among the use of finance and non-finance measures for coping with the impacts of floods.

An additional household member and an additional household income earner are associated with lower probability of not using any of the finance or non-finance coping mechanisms; while ASAL-residing households have a higher probability of not using any of the finance or non-finance coping mechanisms compared to non-ASAL households $P(00)$. Floods tend to pose challenges mostly in densely populated areas, and this may explain why overall ASAL households tend to have little incentives to undertake coping measures against it, compared to non-ASAL households. With regards to non-finance coping only $P(01)$, urban households are have lower probability of usage compared to rural households; and an additional household income earner is associated with a higher probability of usage. ASAL households have a higher probability of using non-finance coping mechanisms compared to non-ASAL households. For finance coping, $P(10)$, urban households have a higher probability of usage compared with rural households; additional household income is associated with lower probability of usage; and ASAL households are associate with lower probability of usage compared to non-ASAL households. For the joint usage of finance and non-finance coping mechanisms $P(11)$, an additional household member is associated with higher probability of usage; while an additional year of household head's formal education and ASAL residence are associated with lower probability of usage.

Table 4.7a: Bivariate probit marginal effects: Finance and non-finance coping mechanisms

| Variables | $P(00)$ None of finance or non-finance | $P(01)$ Non-finance only | $P(10)$ Finance only | $P(11)$ Finance and non-finance |
|--------------------------------------|---|--------------------------------|-------------------------|---------------------------------------|
| Cluster: Urban | 0.0221 (0.0408) | -0.0971*** (0.0310) | 0.0167*** (0.00613) | 0.0583 (0.0393) |
| Household size | -0.0195*** (0.00741) | 0.00318 (0.00602) | -0.000167 (0.00124) | 0.0164** (0.00673) |
| No. of household income earners | -0.0534*** (0.0182) | 0.0438*** (0.0150) | -0.00809** (0.00341) | 0.0176 (0.0150) |
| HH head years of formal education | 0.0106*** (0.00395) | 0.00268 (0.00331) | -0.000865 (0.000726) | -0.0124*** (0.00372) |
| Age of household head | 0.00129 (0.00733) | -0.00227 (0.00468) | 0.000459 (0.000970) | 0.000523 (0.00662) |
| Square of age of household head | -4.87e-06 (6.76e-05) | 2.55e-05 (4.67e-05) | -5.41e-06 (9.68e-06) | -1.52e-05 (6.08e-05) |
| Gender of household head: Male | 0.0197 (0.0482) | -0.0140 (0.0385) | 0.00245 (0.00743) | -0.00819 (0.0444) |
| Semi-arid:10-29% aridity | 0.402*** (0.0560) | 0.0653 (0.0420) | -0.0282*** (0.00799) | -0.439*** (0.0490) |
| Semi-arid:30-84% aridity | 0.252*** (0.0465) | 0.124*** (0.0338) | -0.0265*** (0.00788) | -0.349*** (0.0494) |

| | | | | |
|----------------------|--------------------|----------------------|-------------------------|-----------------------|
| Arid:85-100% aridity | 0.105* (0.0610) | 0.237*** (0.0557) | -0.0299*** (0.00782) | -0.313*** (0.0591) |
| Observations | 1,222 | 1,222 | 1,222 | 1,222 |

Data Source: (KIPRA, 2018)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

b) Use of Formal Finance and Informal Finance Coping Mechanisms

The correlation ρ , among the use of formal finance and informal finance coping mechanisms is negative (-0.8131781) and statistically significant ($Prob > \chi^2 = 0.0000$) at 5% significance level. This provides evidence of suitability of the bivariate Probit model. The negative correlation as indicated by ρ suggests substitutability among the use of finance and non-finance measures for coping with the impacts of floods. For the usage of informal finance $P(01)$, ASAL households have higher probability of usage compared to non-ASAL households. For the usage of formal finance $P(10)$, urban households have a lower probability of usage compared to rural households; while for ASAL households the probability of usage compared to non-ASAL households is initially lower and then becomes higher for increasing level of aridity. For the joint usage of formal and informal finance $P(11)$, urban households have higher probability of usage compared to rural households; while for ASAL households the probability of usage is initially higher and then becomes lower for households residing in much highly arid counties, compared to the non-ASAL households.

Table 4.7b: Bivariate probit marginal effects: Formal finance and informal finance coping mechanisms

| Variables | $P(00)$ None of formal finance or non-finance | $P(01)$ Informal finance only | $P(10)$ Formal finance only | $P(11)$ Formal finance and informal finance |
|--------------------------------------|---|--|-----------------------------------|---|
| Cluster: Urban | -0.0103 (0.00662) | 0.00803 (0.0212) | -0.170*** (0.0589) | 0.172*** (0.0545) |
| Household size | -0.00120 (0.00128) | 0.00194 (0.00341) | -0.0279* (0.0158) | 0.0272* (0.0140) |
| No. of household income earners | -0.00255 (0.00407) | -0.0107 (0.0110) | 0.0346 (0.0268) | -0.0213 (0.0250) |
| HH head years of formal education | -0.000258 (0.000853) | 0.000182 (0.00216) | -0.00451 (0.00739) | 0.00458 (0.00670) |

| | | | | |
|---------------------------------|-------------------------|------------------------|-------------------------|------------------------|
| Age of household head | 0.000332 (0.00131) | -0.00118 (0.00323) | 0.0118 (0.0124) | -0.0109 (0.0112) |
| Square of age of household head | -2.09e-06 (1.15e-05) | 1.49e-05 (2.74e-05) | -0.000121 (0.000113) | 0.000108 (0.000103) |
| Gender of household head: Male | -0.0144 (0.00963) | -0.0481 (0.0325) | 0.104 (0.0882) | -0.0413 (0.0740) |
| Semi-arid:10-29% aridity | 0.117 (0.0905) | 0.121* (0.0730) | -0.110 (0.122) | -0.128* (0.0752) |
| Semi-arid:30-84% aridity | 0.00485 (0.00365) | 0.127*** (0.0414) | -0.362*** (0.0767) | 0.230*** (0.0769) |
| Arid:85-100% aridity | 0.0242 (0.0214) | 0.00110 (0.0141) | 0.141*** (0.0539) | -0.166*** (0.0442) |
| Observations | 279 | 279 | 279 | 279 |

Data Source: (KIPPRA, 2018)

Standard errors in parentheses

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*

c) Use of Formal Non-Finance and Informal Non-Finance Coping Mechanisms

The correlation, ρ , among the formal non-finance and informal non-finance is negative (-0.7300745) and statistically significant ($Prob > \chi^2 = 0.0107$) at 5% significance level. The statistically significant coefficient on ρ provides evidence of suitability of the bivariate Probit model. The negative coefficient on ρ suggests substitutability among the use of formal non-finance and informal non-finance mechanisms for coping with the impacts of floods. With regards to the usage of informal non-finance $P(01)$, urban households and ASAL (30-84% aridity) households have lower probability of usage compared to the respective base categories -rural households and non-ASAL households, respectively. With regards to the joint usage $P(11)$, urban households have higher probability of usage compared to rural households. An additional age of the household head is associated with a higher probability of jointly using formal non-finance and informal non-finance coping mechanisms $P(11)$, to cope with floods. ASAL (30-84% aridity) households have higher probability of jointly using formal and informal non-finance coping mechanisms compared to non-ASAL households.

Table 4.7c: Bivariate probit marginal effects: Formal non-finance and informal non-finance coping mechanisms

| Variables | <i>P</i> (00) None of formal non- finance or informal non- finance | <i>P</i> (01) Informal non-finance only | <i>P</i> (10) Formal non- finance only | <i>P</i> (11) Formal non- finance and informal non-finance |
|--------------------------------------|---|--|--|--|
| Cluster: Urban | 0.0112 (0.00694) | -0.205*** (0.0514) | 0.0376* (0.0214) | 0.157*** (0.0482) |
| Household size | -0.00292 (0.00200) | 0.0118 (0.0103) | -0.00513 (0.00338) | -0.00374 (0.0101) |
| No. of household income earners | -0.00271 (0.00528) | 0.0332 (0.0268) | -0.00811 (0.00881) | -0.0224 (0.0234) |
| HH head years of formal education | -0.000190 (0.000623) | 0.00150 (0.00484) | -0.000445 (0.00106) | -0.000866 (0.00415) |
| Age of household head | -0.000531 (0.000989) | -0.0181* (0.0101) | 0.00211 (0.00259) | 0.0166** (0.00844) |
| Square of age of household head | 7.95e-06 (8.91e-06) | 0.000151 (9.19e-05) | -1.35e-05 (1.95e-05) | -0.000145* (7.93e-05) |
| Gender of household head: Male | -0.00747 (0.0108) | 0.0213 (0.0633) | -0.0122 (0.0229) | -0.00163 (0.0481) |
| Semi-arid:10-29% aridity | -0.00903 (0.00608) | -0.0676 (0.116) | -0.0197 (0.0128) | 0.0963 (0.116) |
| Semi-arid:30-84% aridity | -0.00896 (0.00600) | -0.264*** (0.0984) | -0.0122 (0.0132) | 0.285*** (0.0984) |
| Arid:85-100% aridity | 0.0334 (0.0382) | -0.130 (0.0914) | 0.0659 (0.0462) | 0.0304 (0.0758) |
| Observations | 261 | 261 | 261 | 261 |

Data Source: (KIPPRA, 2018)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

4.3 Household Resilience

The resilience was operationalized as to whether the household had lacked enough food for any of the 12 months preceding the KIPPRA Survey (February 2017 – January 2018), coded 1 (reported to have lacked enough food for at least one month) or zero otherwise. The question on lack of food was directly posed to the households at the time of the survey. The binary nature of the dependent variable makes qualitative response models such as Logit or Probit appropriate, with the maximum likelihood method of estimation. The Probit Model is utilised for the reasons elaborated in Section 3.3.

4.3.1 Household Resilience Descriptive Statistics

This section provides analysis of the effects of finance and non-finance coping mechanisms on the households' resilience to the impacts of droughts and floods. The roles of other factors (controls') are also highlighted. The 2018 KIPRPA Survey shows that that majority (53.4%) of the sampled households reported to have lacked food for at least one month among the 12 months preceding the survey period. Given that 48% of the sampled households reside in urban areas, one would plausibly expect the majority (52%) that reside in rural areas would probably engage in economic activities such as agriculture and livestock keeping that are prone to adverse climatic shocks such as droughts and floods. Average household size is 4.9 persons (5 persons approximately) while the average number of income earners per household is about 1.2 persons (approximately one person). The average household size of 5 is slightly above the national average of 4 (KNBS, 2018b) possibly due to higher number of average household sizes in ASAL counties. The high number of average household size relative to the average household income earners translates to a high dependency ratio, which can perhaps make households prone to external shocks due to limited diversification of household incomes and increased burden that constrains adaptation (FAO, 2016). The average years of education completed by the household head is 8.4 years, suggesting majority completed only primary level education. About 74.6% of the surveyed households are male-headed, which is closely comparable to the national estimate of 70% (KNBS, 2018b). With regards to the coping mechanisms, for finance coping mechanisms the mean of 0.79 suggests most of the households do not use finance (either formal or informal) as a coping mechanism. The mean of 1.15 for non-finance coping mechanisms suggests household mostly rely on informal non-finance coping mechanisms.

Table 4.8: Descriptive statistics

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|-----------------------------------|-------|--------|-----------|-----|-----|
| 12-month food access | 1,370 | 0.5343 | 0.4990 | 0 | 1 |
| Cluster type | 1,369 | 0.4820 | 0.4999 | 0 | 1 |
| Household size | 1,370 | 4.9320 | 2.6080 | 1 | 22 |
| Household income earners | 1,357 | 1.2290 | 0.9837 | 0 | 10 |
| Household head years of education | 1,357 | 8.4266 | 5.4077 | 0 | 23 |
| Household head gender | 1,369 | 0.7462 | 0.4353 | 0 | 1 |
| Finance coping measures | 1,370 | 0.7946 | 0.4980 | 0 | 2 |
| Non-finance coping measures | 1,370 | 1.1464 | 0.7115 | 0 | 2 |

Data Source (KIPPRA, 2018)

4.3.2 Resilience Regression Results

The Probit regression results show significant marginal effects for cluster (rural vs urban), household size, education level of the household head, and aridity intensity of the county. For the combined coping effects of droughts and floods, households living in urban areas have a 15.0 percentage point lower probability of lacking resilience compared to rural households. While rural households are food producing agents, dominant rural economic activities such as agriculture and livestock production are disproportionately prone to the impacts of droughts and floods, which may explain their higher vulnerabilities. Almost similar observations are made for coping mechanisms associated with *droughts only* and *floods only* cases (columns (b) and (c) of Table 4.9), respectively.

An additional household member is associated with a higher probability of about 2.6 percentage points of lacking resilience, across the three models: *drought and floods*, *drought only* and *floods only*. This might reflect the fact that larger households are more prone to poverty and high dependency ratios. Households headed by persons with more years of education demonstrate higher probability of resilience - An additional year of formal education is associated with about 1.2 percentage points lower probability of lacking resilience with regards to the combined coping mechanisms for droughts and floods. The result is almost similar and robust for “*drought only*” and “*floods only*” coping mechanisms. The effects of education on the household resilience can be attributed to resources associated with human capital investments such as income generating opportunities (FAO, 2016). At higher levels of aridity, households become more vulnerable possibly

due to exposures especially relating to droughts. ASAL households residing in counties with 30-84% aridity have a higher probability of 11.6 percentage points of lacking resilience while the households in counties with aridity levels of 85-100% have a higher probability of 20.1 percentage points of lacking resilience compared to households residing in non-ASAL counties with regards to the combined effects of droughts and floods. Similar findings are observed for “*drought only*” and “*floods only*” contexts. There is no evidence that use of financial instruments at aggregated levels or “strands” (savings, credit, investment and insurance) impacts on households’ resilience with regards to food access measure after controlling for the range of covariates included in the regression models.

The subsequent subsection of the analyses disaggregates finance coping mechanisms into credit and savings and the findings suggest that source of credit and where households save indeed matters. With regards to the use of non-finance coping mechanisms, use of formal non-finance coping mechanisms enhance household resilience for the “*drought only*” context. Surprisingly, for “*floods only*” context the results show that use of formal non-finance worsens resilience relative to the households that do not employ any non-finance coping mechanism. This may be explained by sudden-onset nature of floods with the associated rapid impacts, as compared to droughts that tend to be slow-onset in nature that allow for interventions before full-scale impacts.

Table 4.9: Probit marginal effects of household resilience

| Dependent Variable, DV: 1 = Lacked food for at least one of the 12 months preceding the survey; 0 = Had not lacked food (base, 0) | | | |
|--|------------------------------|-------------------------|-------------------------|
| Variables | (a) Drought and floods | (b) Drought only | (c) Floods only |
| Cluster: Urban | -0.150*** (0.0409) | -0.134*** (0.0409) | -0.153*** (0.0419) |
| Household Size | 0.0266*** (0.00808) | 0.0246*** (0.00763) | 0.0268*** (0.00798) |
| Number of Household Income Earners | -0.0215 (0.0183) | -0.0265 (0.0177) | -0.0230 (0.0183) |
| Years of Education Completed by Household Head | -0.0121*** (0.00403) | -0.0116*** (0.00381) | -0.0126*** (0.00393) |
| Gender of Household Head: Male | -0.0191 (0.0446) | -0.0161 (0.0437) | -0.0104 (0.0436) |
| Finance Coping: Informal | 0.0622 (0.0700) | 0.0644 (0.0674) | -0.0329 (0.0942) |

| | | | |
|---------------------------------|----------------------|----------------------|----------------------|
| Finance Coping: Formal | 0.0415 (0.0817) | -0.0808 (0.156) | -0.0305 (0.0606) |
| Non-finance coping: Informal | -0.111 (0.0727) | -0.0994 (0.0720) | -0.00582 (0.0446) |
| Non-finance coping: Formal | -0.0873 (0.0811) | -0.152** (0.0742) | 0.393*** (0.102) |
| Semi-arid:10-29% aridity | -0.0496 (0.0584) | -0.0200 (0.0654) | -0.0538 (0.0580) |
| Semi-arid:30-84% aridity | 0.116** (0.0556) | 0.131** (0.0598) | 0.0973** (0.0468) |
| Arid:85-100% aridity | 0.201*** (0.0663) | 0.220*** (0.0668) | 0.184*** (0.0563) |
| Observations | 1,342 | 1,342 | 1,342 |

Data Source: (KIPRA, 2018)

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

To gain additional insights into the role of finance in households' coping with the impacts of drought and floods, the variable for finance was disaggregated into its two main components; savings and credit (Table 4.10). The significance of the marginal effects for the control variables largely remain unchanged. The findings suggest that use of informal credit worsens household resilience compared to the base (those not borrowing to cope with drought or flood). These findings may suggest the covariate nature of climate-induced shocks that tend to affect many households simultaneously. It is possible that households that demand informal credit are driven by the need to get external support, yet at those times credit from informal sources that generally anchor on social networks is weak in providing the required support. There is no evidence of formal credit impacting on the household resilience. Disaggregating formal credit into its components such as borrowings from banks, SACCOs, MFIs and government sources yield similar results. The implications of these findings are that *ex-ante* finance coping measures (e.g. savings or insurance) are better in building resilience than *ex-post* finance coping measures. *Ex-post* coping mechanisms are generally less effective as they are less reliable in availability and when available can take longer response time (Clarke & Dercon, 2016). Formal savings as proxied by bank savings enhances household resilience. Considering droughts and floods combined, households that reported to have saved with banks have a lower probability of 12.5 percentage points of lacking resilience compared to those who do not save with banks. Almost similar results were obtained for “*drought only*” and “*floods only*” contexts. These findings suggest that within an access strand, different components of financial instruments may have varying significance of cushioning households, and that

access to formal savings is vital for building household resilience.

Table 4.10: Probit marginal effects of household resilience

| Dependent Variable, DV: 1 = Lacked food for at least one of the 12 months preceding the survey; 0 = Had not lacked food (base, 0) | | | |
|--|-------------------------|-------------------------|-------------------------|
| Variables | Drought and floods | Drought only | Floods only |
| Cluster: Urban | -0.139*** (0.0412) | -0.126*** (0.0406) | -0.150*** (0.0411) |
| Household Size | 0.0254*** (0.00823) | 0.0246*** (0.00810) | 0.0255*** (0.00809) |
| Number of Household Income Earners | -0.0184 (0.0177) | -0.0226 (0.0174) | -0.0189 (0.0178) |
| Years of Education Completed by Household Head | -0.0122*** (0.00401) | -0.0119*** (0.00390) | -0.0126*** (0.00399) |
| Gender of Household Head: Male | -0.0145 (0.0435) | -0.0114 (0.0431) | -0.00807 (0.0428) |
| Credit: Informal | 0.148** (0.0605) | 0.149** (0.0600) | 0.134** (0.0603) |
| Credit: Formal | 0.135 (0.0832) | 0.132 (0.0836) | 0.135 (0.0825) |
| Saving: Bank | -0.125** (0.0626) | -0.123** (0.0625) | -0.132** (0.0620) |
| Non-finance coping: Informal | -0.0758 (0.0528) | -0.0627 (0.0604) | -0.0259 (0.0376) |
| Non-finance coping: Formal | -0.0473 (0.0619) | -0.104* (0.0582) | 0.371*** (0.0938) |
| Semi-arid:10-29% aridity | -0.0404 (0.0564) | -0.0160 (0.0603) | -0.0437 (0.0550) |
| Semi-arid:30-84% aridity | 0.105** (0.0513) | 0.125** (0.0578) | 0.0880** (0.0443) |
| Arid:85-100% aridity | 0.213*** (0.0591) | 0.238*** (0.0636) | 0.197*** (0.0531) |
| Observations | 1,342 | 1,342 | 1,342 |

Data Source: (KIPPRA, 2018)

Standard errors in parentheses

**** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$*

5. Conclusion and Policy Recommendations

5.1 Conclusion

Climate-induced hazards such as droughts and floods impose significant impacts on households through channels such as income and asset losses. These in turn have other negative socio-economic consequences such as poor health outcomes and poverty. Addressing the impacts of climate-induced shocks are therefore of significant interests to the realisation of national development goals and programmes such as those envisioned in the Kenya Vision 2030 and the Big Four Agenda; as well as global and regional commitments including the SDGs and the AU Agenda 2063. With climate change projected to increase, the scale, severity and frequency of droughts and floods are poised to rise. It is thus imperative to understand how households cope with the impacts of droughts and floods and factors that affect household resilience so that relevant policies can be appropriately designed and implemented. This study had three objectives. The first one was to determine different coping mechanisms households in Kenya use to cope with droughts and floods. These included finance and non-finance coping mechanisms. The second aim was to establish socio-economic, geographic and agro-climatic characteristics that determine the choice of household coping mechanisms that were broadly grouped into finance and non-finance measures. The third aim was to analyse factors determining household resilience to the impacts of droughts and floods, including use of finance. Focusing on these aspects are of policy imperative given that the covariate and recurrent nature of droughts and floods make some household coping mechanisms less effective. In achieving these objectives, the study employed review of relevant policies, review of literature on selected interventions, analyses of the 2015/2016 KIHBS cross-sectional data, and in-depth analyses of a cross-sectional primary household survey data collected in early 2018 which covered 27 Kenyan counties that are prone to droughts and floods.

The findings suggest several interesting insights for policy. There exists multiple policies and institutions aimed at addressing climate change and climate-induced risks at global and national levels. To create synergy, policy and institutional coherence are imperative. There are indications that linking customary/traditional institutions with formal institutions can yield positive outcomes in shaping community coping mechanisms that benefits households. Review of existing interventions indicate the importance of partnerships (government, private sector, research institutions and development partners) in designing, piloting and rolling out of innovative market-based products; and supporting development of

soft and physical infrastructure for advancing innovative market-based products. Moreover, the evidence underscores the importance of addressing demand side barriers such as poverty, cultural barriers and financial illiteracy. The 2015/2016 KIHBS, and the 2018 KIPPRA survey results also show that households use multiple coping mechanisms including finance and non-finance measures. The usages of these coping mechanisms depend on socio-economic characteristics of the households such as gender, age, income and education level; as well as geographic and agro-climatic contexts. ASAL households largely depend on non-finance coping mechanisms while non-ASAL households demonstrate higher usage of finance as a coping mechanisms. Among the main non-finance coping mechanisms used are reduced food consumption, sell of livestock and working for longer hours. These measures are largely considered unsustainable given the recurrent nature of droughts and floods. The use of finance and non-finance coping mechanisms largely demonstrate complementarities, which might suggest access to finance can indirectly boost household coping mechanisms through non-finance measures. Some of the challenges noted to hinder usage of finance as a coping mechanism include low and fluctuating household incomes that can affect affordability; financial illiteracy; and high costs of credit and insurance premiums. Nonetheless, some opportunities seen in the usage of finance and generally market-based coping mechanisms include emergence of technology and innovative products. The Kenya Vision 2030 flagships projects, particularly those relating to infrastructure are viewed as providing opportunities for adaptations and resilience through market integration opportunities as well as timely response of private coping mechanisms to climate change induced risks. Despite these opportunities, slow response of financial institutions to the dynamics of droughts and floods, poor infrastructure such as communication networks in rural settings are seen to erode the potential benefits. An important insight from these findings is that building household coping mechanisms should be seen in a bigger picture of supporting private sector development. The analyses also demonstrate that access to modern avenues for accessing weather forecast information is key to promoting household coping mechanisms and resilience, especially for the case of droughts. This finding suggests the significant roles institutions such as the Kenya Meteorological Department can play in household coping mechanism and resilience towards climate change induced risks. The analyses also suggest that urban households, more years of formal education and use of formal savings tend to enhance household resilience to the impacts of droughts and floods. Larger households, ASAL households and use of informal credit are associated with lower household resilience. Together these findings suggest importance of human capital development, and possibly reduced dependency ratio as some of the avenues that can be exploited in building household resilience.

5.2 Recommendations

5.2.1 Policy Recommendations

Initiatives to enhance household coping mechanisms and resilience to the risks posed by drought and flood hazards should consider:

- i) Developing robust partnerships between the government, research organisations and the private sector in developing initiatives to cushion households against the adverse impacts of droughts and floods. Some of the issues for consideration in building a successful partnership include technical support, resource mobilization and market development.
- ii) Entrenching a robust institutional coordination. There exists multiple policies and institutions for managing climate change and adaptations to climate change-risks. One of the challenges that was for instance pointed out is that the county steering group operates on voluntary basis and this may affect effective participation of the actors, especially non-state players. This might therefore require review of coordination framework. It is also important to review how national and county level institutional players link together for effective coordination. It is evident linking customary/traditional institutions with formal institutions bear positive results in building community and household coping mechanisms. These insights call for taking stocks of such customary/traditional institutions and explore opportunities for partnerships and synergy.
- iii) Geographical and agro-climatic contexts. The impacts of droughts and floods vary by geographic and agro-climatic zones, such as urban vs. rural divide, and ASAL vs. non-ASAL divide. Generally rural households and those in ASAL counties are more vulnerable to the impacts of droughts and floods partly due to their exposures to climate-change induced hazards and limited opportunities in coping mechanisms, which requires tailored policy interventions.
- iv) Development of human capital through formal education tends to be associated with use of formal coping mechanisms and better resilience outcomes. This finding has two policy implications. The first one is that it justifies enhanced human capital development. The second is that households with weak human capital development tend to rely on informal or none of the coping mechanisms which compounds their vulnerabilities to the impacts of droughts and floods. Household level interventions for better coping mechanisms and resilience can therefore be tailored to levels of human capital development.

- v) Enhancing programmes to deepen access to formal financial instruments particularly savings, as they tend to enhance household resilience. Expanding usage of formal financial instruments would require addressing some of the challenges that are evident from the analyses including poverty, deficits in infrastructure that support expansion of formal financial services and financial illiteracy. Supply side constraints such as high costs of credit and insurance premium also need to be addressed.
- vi) Enhancing access to climate forecast information. Such initiatives can leverage on modern technologies such as Short Message Service (SMS) alerts besides the traditional print and audio-visual media. In this regard enhancing the presence and roles of institutions such as the Kenya Meteorological Department is imperative.
- vii) Building household coping mechanisms as part of the larger private sector development initiatives. Such an approach calls for enhanced efforts in supporting soft and physical infrastructure for linking households to the markets and information on climate change and weather forecasts.

5.2.2 Areas for Further Research

Research on household coping mechanisms and resilience towards risks imposed by climate change hazards such as droughts and floods is still growing and more needs to be done both in terms of methodological approaches and areas for consideration especially in developing countries. Given that that global commitments including SDGs and the Sendai Framework for Disaster Risk Reduction 2015-2030 call for building resilience at all levels and mitigation of risks posed by climate change induced hazards, more empirical work is required in future. Future research and research-related activities can consider:

- i) Building rich longitudinal datasets and undertaking analysis to understand household coping mechanisms and resilience over time. More research is needed in areas of use of finance and non-finance coping mechanisms in dynamic contexts.
- ii) Deepening insights on ways of addressing constraints identified in use of finance coping mechanisms such as costs, financial illiteracy, product designs and social-cultural barriers.
- iii) Consider composite measures of household resilience to address the complex nature of the resilience dynamics.

References

- ACRE Africa. (2018). *Our Achievements*. Retrieved March 30, 2019, from ACRE Africa: <http://acreafrica.com/achievements/>
- African Union. (2014). *Agenda 2063: The Africa we Want* (Second ed.). Addis Ababa: African Union.
- Agrawal, A., & Perrin, N. (2009). Climate Adaptation, Local Institutions and Rural Livelihoods. In A. W. N, I. Lorezoni, & K. L. O'brien (Eds.), *Adaptation to Climate Change: Thresholds, Values and Governance* (pp. 350-367). New York: Cambridge University Press.
- Alderman, H., & Haque, T. (2007). *Insurance Against Covariate Shocks: The Role of Index Based Insurance in Social Protection in Low-Income Countries of Africa*. Washington D.C.: World Bank Working Paper No. 95.
- Arouri, M., Nguyen, C., & Youssef. (2015). Natural Disasters, Household Welfare, and Resilience: Evidence from Rural Vietnam. *70*, 59-77.
- Association of Kenya Insurers. (2015). *Insurance Industry Annual Report 2014*. Nairobi: AKI.
- Association of Kenya Insurers. (2016). *Insurance Industry Annual Report 2015*. Nairobi: AKI.
- Association of Kenya Insurers. (2017). *2016 Insurance Industry Annual Report*. Nairobi: AKI.
- Association of Kenya Insurers . (2018). *AKI Insurance Industry Annual Report 2017*. Nairobi: Association of Kenya Insurers .
- Aterido, R., Beck, T., & Iacovone, L. (2013). Access to Finance in Sub-Saharan Africa: Is there a Gender Gap? *World Development*, *47*, 102-120.
- Barret, C. B., & Constan, M. A. (2014). Toward a Theory of Resilience for International Development Applications. *PNAS*, *11(40)*, 14625-14630.
- Bhavnani, R., Vordzorbe, S., Owuor, M., & Bousquet, F. (2008). *Report on the Status of Disaster Risk Reduction in the Sub-Saharan Africa Region*. Washington D.C: World Bank. Retrieved August 18, 2018, from https://www.unisdr.org/files/2229_DRRinSubSaharanAfricaRegion.pdf
- Boka, G. T. (2017). *Measuring Resilience to Climate Change in Ethiopia* . Abidjan: African Development Bank Working Paper Series No. 268.
- BOMA Project. (2019). *2018 Annual Report: Changing What is Possible* . BOMA Project. Retrieved April 22, 2019, from <https://bomaproject.org/wp-content/uploads/2019/03/BOMA-Project-2018-Annual-Report.pdf>

- Carter, M. R., Cheng, L., & Sarris, A. (2016). Where and How Index Insurance can Boost the Adoption of Improved Agricultural Technologies. *Journal of Development Economics*, 118, 59-71.
- Castells-Quintana, D., Lopez-Urbe, M. P., & McDermott, K. J. (2018). Adaptation to Climate Change: A Review through Development Economics Lens. *World Development*, 104, 183-196.
- Central Bank of Kenya. (2018a). *The Impact of Interest Rate Capping on the Kenyan Economy - Draft for Comments*. Nairobi: CBK.
- Central Bank of Kenya. (2018b). *Statistical Bulletin, June 2018*. Nairobi: Central Bank of Kenya.
- Central Bank of Kenya. (2018c). *Statistical Bulletin, December 2018*. Nairobi: Central Bank of Kenya.
- Central Bank of Kenya. (2018d). *Bank Supervision Annual Report 2017*. Nairobi: CBK.
- Clarke, D. J., & Dercon, S. (2016). *Dull Disasters? How Planning Ahead will Make a Difference*. Oxford : Oxford University Press .
- Communications Authority of Kenya. (2019). *Third Quarter Sector Statistics Report for the Financial Year 2018/2019 (January-March 2019)*. Nairobi: Communications Authority of Kenya. Retrieved from <https://ca.go.ke/wp-content/uploads/2018/12/Sector-Statistics-Report-Q1-2018-2019.pdf>
- Crick, F., Eskander, S. M., Fankhausa, S., & Diop, M. (2018a). How African SMEs Respond to Climate Risks? Evidence from Kenya and Senegal. *World Development*, 108, 157-168.
- Crick, F., Gannon, K. E., Diop, M., & Sow, M. (2018b). Enabling Private Sector Adaptation to Climate Change in Sub-Saharan Africa. *WIREs Clim Change*, 1-17.
- Elhadi, Y. (2018). *Strengthening County Integrated Development Plan Process: Contribution of County Climate Change Fund Mechanism*. Ada Consortium Policy Brief Issue 2018/2. Nairobi: Ada Consortium. Retrieved from <https://www.adaconsortium.org/index.php/component/k2/item/390-strengthening-the-cidp-process-and-contribution-of-ccc-fund-mechanism>
- FAO. (2016). *Resilience Index Measurement and Analysis - II*. Rome: FAO. Retrieved from <http://www.fao.org/3/a-i5665e.pdf>
- Federal Emergency Management Agency. (2018). *National Flood Insurance Program - Claims Manual*. Washington, D.C. Retrieved April 17, 2019, from https://www.fema.gov/media-library-data/1545341575691-f4a7faef90ceac88f130dfc158b506f9/NFIPClaimsManual_withcover_v6_Guidehouse_092718.pdf

- FinAccess. (2019a). *2019 FinAccess Household Survey on Financial Inclusion*. Nairobi: CBK/KNBS/FSD Kenya.
- FinAccess. (2019b). *2019 FinAccess Household Survey Key Findings Lunch Presentation*. Nairobi: CBK/KNBS/FSD Kenya. Retrieved April 20, 2019, from <https://www.knbs.or.ke/download/2019-finaccess-survey-launch-presentation/>
- Financial Protection Forum. (2016). *Documentary: Kenya Livestock Insurance Program (KLIP)*. Recovery, Global Facility for Disaster Reduction and. Retrieved April 22, 2019, from <https://www.financialprotectionforum.org/files/documentary-kenya-livestock-insurance-program-klip>
- Gao, J., & Mills, B. F. (2018). Weather Shocks, Coping Strategies, and Consumption Dynamics in Rural Ethiopia . *World Development* , 101, 268-283.
- Gautman, M. (2006). *Managing Drought in Sub-Saharan Africa: Policy Perspectives*. A Paper Presented at IAAE Conference, Queensland, Australia, 12th-18th August 2006.
- Gebremeskel, G., Tang, Q., Sun, S., Huang, Z., Zhang, X., & Liu, X. (2019). Droughts in East Africa: Causes, Impacts and Resilience . *Earth-Science Reviews* , 193, 146-161.
- GoK. (2007). *Kenya Vision 2030: A Globally Competitive and Prosperous Kenya* . Nairobi : Ministry of Planning and National Development .
- GoK. (2012). *Sessional Paper No. 8 of 2012 on National Policy for Sustainable Development of Northern Kenya and Other Arid Lands*. Nairobi: Ministry of State for Development of Northern and Other Arid Lands.
- GoK. (2013b). *Sector Plan for Drought Risk Management and Ending Drought Emergencies*. Nairobi: Ministry of Devolution and Planning.
- GoK. (2014). *Summarized Version of National Emergency Response Plan & Standard Operating Procedures (SOPs)*. Nairobi: Ministry of Interior and Coordination of National Government/National Disaster Management Unit (NDMU). Retrieved from <http://www.disastermanagement.go.ke/publications/>
- GoK. (2015). *Ending Drought Emergencies Common Programme Framework* . Nairobi: Ministry of Devolution and Planning.
- GoK. (2016a). *Climate Change Act No. 11 of 2016*. Nairobi: National Council for Law Reporting.
- GoK. (2016b). *Kenya National Adaptation Plan 2015-2030: Enhanced Climate Resilience towards the Attainment of Vision 2030 and Beyond*. Nairobi: Ministry of Environment and Natural Resources.

- GoK. (2017). *National Disaster Risk Management Policy* . Nairobi: Government of Kenya .
- GoK. (2018a). *Third Medium Term Plan 2018-2022*. Nairobi: The National Treasury and Planning.
- GoK. (2018b). *National Climate Change Action Plan (Kenya) 2018-2022*. Nairobi: Ministry of Environment and Forestry .
- Greatrex, H., Hansen, J., Garvin, S., Diro, R., Blakeley, S., Le Guen, M., . . . Osgood, D. (2015). *Scaling Up Index Insurance for Small-Holder Farmers: Recent Evidence and Insights* . CCAFS Report No. 14 Copenhagen: CGIAR Research. Retrieved from www.ccafs.cgiar.org
- Greene, W. H. (2018). *Econometric Analysis* (8th ed.). New York : Pearson Education, Inc.
- Greiving, S. (2006). Integrated Risk Assessment of Multi-Hazards: A New Methodology. In Schmidt-Thome' (Ed.), *Natural and Technological Hazards and Risks Affecting the Spatial Development of European Regions* (Vol. 42, pp. 75-81). Espoo.
- Hansen, J. W., Dilley, M., Goddard, L., Ebrahimian, E., & Ericksen, P. (2004). *Climate Variability and the Millenium Development Goals Hunger Target*. The International Research Institute for Climate Prediction Technical Report No. 04-04.
- Hill, R. V., & Porter, C. (2017). Vulnerability to Drought and Food Price Shocks: Evidence from Ethiopia. *World Development*, 96, 65-77.
- Holling, C. S. (1973). Resilience and Stability of Ecological Systems . *Annual Review of Ecology and Systematics* , 4, 1-23.
- Insurance Regulatory Authority. (2018). *Insurance Industry Annual Report 2017*. Nairobi: IRA.
- IPCC. (2013). Summary for Policymakers. In T. F. Stocker, D. Qin, G. K. Plattner, M. Tignor, S. K. Allen, J. Boschung, . . . P. M. Midgley (Eds.), *Climate Change 2013: The Physical Science Basis. Contribution of Working Group I to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press.
- IPCC. (2014). *Climate Change 2014: Impacts, Adaptation, and Vulnerability: Part A - Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change*. (C. B. Field, V. R. Barros, D. J. Dokken, K. J. Mach, M. D. Mastrandrea, T. E. Bilir, . . . L. L. White, Eds.) Cambridge: Cambridge University Press.

-
- Jensen, N., & Barret, C. (2017). Agricultural Index Insurance for Development. *Applied Economic Perspectives and Policy*, 39(2), 199-219.
- Jensen, N. D., Barrett, C. B., & Mude, A. (2017). Cash Transfers and Index Insurance: A Comparative Impact Analysis from Northern Kenya. *Journal of Development Economics*, 129, 14-28.
- Johnson, L., Wandera, B., Jensen, N., & Banerjee, R. (2018). Competing Expectations in an Index-Based Livestock Insurance Project. *The Journal of Development Studies*. doi:10.1080/00220388.2018.1453603
- Johnson, S. (2004). Gender Norms in Financial Markets: Evidence from Kenya. *World Development*, 32(8), 1355-1374.
- KIPPRA. (2018). *Building Resilience to Mitigate the Impact of Drought and Floods in Kenya Survey Data*. Nairobi: KIPPRA .
- KNBS. (2016). *Strategic Plan for Agricultural and Rural Statistics (SPARS - Kenya) 2015-2022*. Nairobi: KNBS.
- KNBS. (2018a). *2015-2016 Kenya Integrated Household Budget Survey*. Nairobi: KNBS.
- KNBS. (2018b). *Basic Report: Based on 2015/16 Kenya Integrated Household Budget Survey (KIHBS)*. Nairobi: KNBS.
- KNBS. (2019). *Economic Survey 2019*. Nairobi: KNBS.
- Leland, H. E. (1968). Saving and Uncertainty: The Precautionary Demand for Saving. *The Quarterly Journal of Economics*, 82(3), 465-473.
- Lohmann, S., & Lechtenfeld, T. (2015). The Effect of Drought on Health Outcomes and Health Expenditures in Rural Vietnam. *World Development*, 72, 432-448.
- Long, J. S., & Freese, J. (2014). *Regression Models for Categorical Dependent Variables Using Stata* (3rd ed.). Texas: Stata Press .
- Lugilde, A., Bande, R., & Riveiro, D. (2019). Precautionary Saving: A Review of Empirical Literature . *Journal of Economic Surveys*, 33(2), 481-515.
- Malkamäki, M. (2011). Informality and Market Development in Kenya's Financial Sector. In *Financial Inclusion in Kenya: Survey Results and Analysis from Finaccess 2009* (pp. 67-87). Nairobi: Financial Sector Deepening Kenya.
- Mathenge, N., Shibia, A. G., Orlando, A. L., & Murithi, F. (Eds.). (2018). Building Resilience to Mitigate the Impact of Droughts and Floods. *Proceedings of the KIPPRA Regional Conference Held from 5th-7th June 2018, Nairobi, Kenya* (p. CP/08/2018). Nairobi: KIPPRA .

- Mendelsohn, R. (2012). The Economics of Adaptation to Climate Change in Developing Countries. *Climate Change Economics*, 3(2), 1250006.
- Ministry of Agriculture, Livestock, Fisheries and Irrigation. (2018). *Executive Seminar on Index Based Livestock Insurance - Summary Report*. Nairobi: Ministry of Agriculture, Livestock, Fisheries and Irrigation. Retrieved March 20, 2019, from http://www.kilimo.go.ke/wp-content/uploads/2018/09/Nairobi_KLIP-Executive-Semiars-Final-Report_IM.pdf
- Ministry of Devolution and ASAL. (2018). *ASALs Categorization*. Retrieved August 17, 2018, from <http://www.devolutionasals.go.ke/county-information/>
- Modigliani, F., & Brumberg, R. (1954). Utility Analysis and the Consumption Function: An Interpretation of the Cross-Section Data . In K. Kurihara (Ed.), *Post-Keynesian Economics* (pp. 388-436). New Brunswick: Rutgers University Press .
- Modigliani, F., & Brumberg, R. (1980). Utility Analysis and Aggregate Consumption Functions: An Attempt at Integration . In *The Collected Papers of Franco Modigliani: Vol 2, the Life Cycle Hypothesis of Saving* (pp. 128-197). Cambridge, MA : The MIT Press .
- Morduch, J. (1995). Income Smoothing and Consumption Smoothing. *Journal of Economic Perspectives*, 9(3), 103-114.
- Mulwa, C., Marenya, P., Rahut, D. B., & Kassie, M. (2017). Response to Climate Risks among Smallholder Farmers in Malawi: A Multivariate Probit Assessment of the Role of Information, Household Demographics, and Farm Characteristics. *Climate Risk Management* , 16, 208-221.
- Mutua, F. M., & Zaki, A. A. (2010). Analyses of Annual Droughts in Kenya Using an Objective Annual Rainfall Drought Index. *Journal of Meteorology and Related Sciences* , 4, 21-33.
- NDMA. (2018). *Annual Reports and Financial Statements for Financial Year Ending 30th June 2018*. Nairobi: NDMA.
- Neef, A., Bengel, L., Boruff, B., Pauli, N., Weber, E., & Varea, R. (2018). Climate Adaptation Strategies in Fiji: The Role of Social Norms and Cultural Values. *107*, 125-137.
- Okuyama, Y., & Sahin, S. (2009). *Impact Estimation of Disasters, a Global Aggregate for 1960 to 2007*. Washington D.C.: The World Bank Policy Research Working Paper No. 4963.
- Opiyo, F., Wasonga, O., Nyangito, M., Schilling, J., & Munang, R. (2015). Drought Adaptation and Coping Strategies among the Turkana Pastoralists of Northern Kenya. *Int J Disaster Risk Sci*, 6, 295-309.

- Oxford Policy Management. (2018). *Evaluation of Kenya Hunger Safety Net Programme Phase 2: Impact Evaluation Final Report Executive Summary*. Oxford: Oxford Policy Management Ltd.
- SASRA. (2017). *The SACCO Supervision Annual Report 2016*. Nairobi: SASRA.
- Scoones, I. (1998). *Sustainable Rural Livelihoods: A Framework for Analysis*. Institute of Development Studies Working Paper 72, 1998.
- Shee, A., Turvey, C. G., & Woodard, J. (2015). A Field Study for Assessing Risk-Contingent Credit for Kenyan Pastoralists and Dairy Farmers. *Agricultural Finance Review*, 75(3), 330-348.
- Shiferaw, B., Tesfaye, K., Kassie, M., Abate, T., Prasanna, B. M., & Menkir, A. (2014). Managing Vulnerability to Drought and Enhancing Livelihood Resilience in Sub-Saharan Africa: Technological, Institutional and Policy Options. *Weather and Climate Extremes*, 3, 67-79.
- Skoufias, E. (2003). Economic Crises and Natural Disasters: Coping Strategies and Policy Implications. *World Development*, 31(7), 1087-1102.
- Tari, D., & Pattison, J. (2014). *Evolving Customary Institutions in the Drylands: An Opportunity for Devolved Natural Resource Governance in Kenya*. IIED Issue Paper . London: IIED.
- Technical Centre for Agricultural and Rural Cooperation, CTA. (2018). *Index-Based Livestock Insurance as an Innovative Tool Against Drought Losses*. Nairobi: CTA. Retrieved from https://cgspace.cgiar.org/bitstream/handle/10568/97904/2044_PDF.pdf?sequence=1&isAllowed=y
- Tran, V. Q. (2015). Household's Coping Strategies and Recoveries from Shocks in Vietnam. *The Quarterly Review of Economics and Finance*, 56, 15-29.
- UN/ISDR. (2007). *Hyogo Framework for Action 2005-2015: Building the Resilience of Nations and Communities to Disasters*. Geneva: UN/ISDR.
- United Nations . (1992). *United Nations Framework Convention on Climate Change*. New York : United Nations.
- United Nations . (1997). *Kyoto Protocol to the United Nations Framework Convention on Climate Chnge*. New York : United Nations .
- United Nations. (2015a). *Transforming Our World: The 2030 Agenda for Sustainable Development*. New York: United Nations.
- United Nations. (2015b). *Paris Agreement*. New York: United Nations.
- United Nations. (2015c). *Sendai Framework for Disaster Risk Reduction 2015-2030*. Geneva: United Nations. Retrieved from https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf

- Université Catholique de Louvain (UCL) - CRED. (2019, April). *EM-DAT: The Emergency Events Database*. Retrieved July 14, 2019, from Université catholique de Louvain (UCL) - CRED: https://www.emdat.be/emdat_db/
- Watanabe, T., Cullmann, J., Pathak, C. S., Turunen, M., Emami, K., Ghinassi, G., & Siddiqi, Y. (2018). Management of Climatic Extremes with Focus on Floods and Droughts in Agriculture . *Irrigation and Drainage*, 67, 29-42.
- Wooldridge, J. M. (2013). *Introductory Econometrics: A Modern Approach* (5th ed.). Mason, OH: South Western/Cengage Learning.
- World Bank . (2001). *Social Protection Sector Strategy: From Safety Net to Springboard*. Washington D.C.: The International Bank for Reconstruction and Development/the World Bank.
- Yang, Y. (2010). Weather Index Derivatives in Risk Transfer for Agricultural Natural Hazards. *Agriculture and Agricultural Science Procedia*, 1, 100-105.

Annexes

Annex 1: Some Financial Institutions providing weather related products*:

| Private Insurance Companies | |
|--|--|
| 1. APA Insurance Company | 7. Madison Insurance Company |
| 2. Kenya Orient Insurance Company | 8. African Merchant Assurance Company Ltd. |
| 3. ICEA Lion General Insurance Company | 9. AON |
| 4. UAP General Insurance Company | 10. Talaful Insurance of Africa |
| 5. Jubilee Insurance Company | 11. Heritage Insurance Company |
| 6. Swiss Re | |
| Research Institutions | |
| International Livestock Research Institute (ILRI) - Piloted index-based livestock insurance in Northern Kenya and provide technical support to private insurance companies in rolling out of index-based livestock insurance | |
| Government | |
| National Government - Funding of KLIP (channelled through private insurers) and the Hunger Safety Net Programme managed through the National Drought Management Authority (NDMA). | |
| Development Partners | |
| International Finance Corporation | |
| World Bank | |
| European Union | |
| Financial Sector Deepening (FSD) Kenya | |

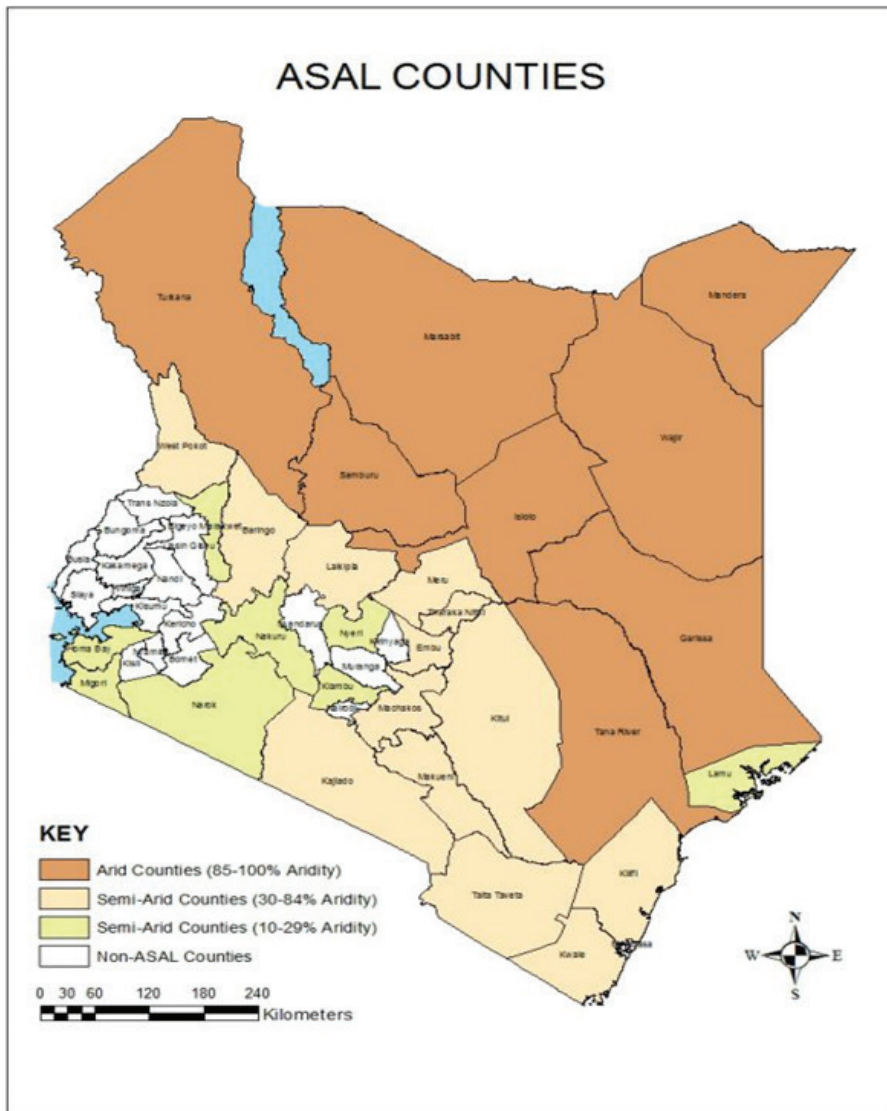
**Insurance Regulatory Authority (IRA) implements the policy on insurance sector while the National Treasury and Planning spearheads the policy developments in the financial sector.*

Annex 2: Counties Covered by the KIPPRA Survey & Response Rates

| County | Aridity Level (%) for ASALs | Number of Household Clusters | No. of Households Targeted | Successful Interviews | Survey Response Rate |
|---------------------|-----------------------------|------------------------------|----------------------------|-----------------------|----------------------|
| 1. Baringo* | 30-84 | 5 | 50 | 50 | 100.0 |
| 2. Elegeyo Maraket* | 10-29 | 5 | 50 | 49 | 98.0 |
| 3. West Pokot* | 30-84 | 5 | 50 | 50 | 100.0 |
| 4. Kajiado* | 30-84 | 5 | 50 | 43 | 86.0 |
| 5. Machakos* | 30-84 | 7 | 70 | 69 | 98.6 |
| 6. Isiolo* | 85-100 | 4 | 40 | 40 | 100.0 |
| 7. Marsabit* | 85-100 | 5 | 50 | 49 | 98.0 |
| 8. Samburu* | 85-100 | 4 | 40 | 40 | 100.0 |
| 9. Embu* | 30-84 | 5 | 50 | 50 | 100.0 |
| 10. Tharaka Nithi* | 30-84 | 5 | 50 | 50 | 100.0 |
| 11. Laikipia* | 30-84 | 5 | 50 | 47 | 94.0 |
| 12. Kitui* | 30-84 | 6 | 60 | 59 | 98.3 |
| 13. Garissa* | 85-100 | 5 | 50 | 50 | 100.0 |
| 14. Tana River* | 85-100 | 4 | 40 | 40 | 100.0 |
| 15. Kilifi* | 30-84 | 7 | 70 | 68 | 97.1 |
| 16. Kwale* | 30-84 | 5 | 50 | 49 | 98.0 |
| 17. Mandera* | 85-100 | 5 | 50 | 48 | 96.0 |
| 18. Turkana* | 85-100 | 5 | 50 | 50 | 100.0 |
| 19. Narok* | 10-29 | 6 | 60 | 60 | 100.0 |
| 20. Makueni* | 30-84 | 6 | 60 | 60 | 100.0 |
| 21. Taita Taveta* | 30-84 | 5 | 50 | 50 | 100.0 |
| 22. Homa Bay* | 10-29 | 6 | 60 | 59 | 98.3 |
| 23. Mombasa | Flood prone | 4 | 40 | 40 | 100.0 |
| 24. Busia | Flood prone | 6 | 60 | 59 | 98.3 |
| 25. Siaya | Flood prone | 6 | 60 | 55 | 91.7 |
| 26. Kisumu | Flood prone | 6 | 60 | 57 | 95.0 |
| 27. Nairobi | Flood prone | 8 | 80 | 69 | 86.3 |
| Total | - | 145 | 1,450 | 1,411 | 97.5 |

Counties classified as ASALS but not in the table (not covered by the survey) with respective aridity levels are Wajir (85-100%); Meru (30-84%); Lamu (10-29%); Nakuru (10-29%); Nyeri (10-29%); Migori (10-29%) and Kiambu (10-29%). Wajir County was initially sampled (5 clusters; 50 households) but was dropped out due to intensified insecurity at the time to the survey. Homa Bay is both a semi-arid (10-29% aridity) and flood prone county. *Represent ASAL counties covered by the NDMA activities.

Annex 3: Geographical Spread of ASAL Counties in Kenya



Source: (Ministry of Devolution and ASAL, 2018)

Annex 4: Groupings of Formal and Informal Coping Mechanisms

| Finance Coping Mechanisms | | Non-Finance Coping Mechanisms | |
|---|--|---|---|
| Formal | Informal | Formal | Informal |
| <ul style="list-style-type: none"> • Saving in banks, MFIs, SACCOs • Borrowing from banks, MFIs, SACCOs • Family insurance cover • Crop insurance cover • Livestock insurance cover • Participation in financial education programme • Invest in financial assets - stocks, bonds • Sell financial assets | <ul style="list-style-type: none"> • Transfers from family/friends • Save with informal finance groups • Borrow from informal finance groups • Borrow from neighbours • Borrow from shylocks • Save in secret places | <ul style="list-style-type: none"> • Depend on national government social transfers • Depend on county government social transfers • Benefit from national government subsidies • Benefit from county government subsidies • Engage in public works for cash or food support • Remittances from within Kenya • Remittances from abroad | <ul style="list-style-type: none"> • Membership of community financing of infrastructure • Invest in physical assets - land, livestock • Seek employment in areas not affected by droughts/floods • Income generating assets from family/friends • Stock and use reserve food • Stock and use non-food reserves • Migration • Irrigation • Dig pans/wells/canal • Installed rain water harvesting • Burning charcoal • Marry away daughter • Distribute family members elsewhere • Enroll children in mobile schools • Benefit from school feeding programmes • Destocking • Fodder stocking • Diversify to other livelihoods |

Annex 5: List of Key Informants

| |
|--|
| <ul style="list-style-type: none"> • Takaful Insurance of Africa • Equity Bank • Kenya Commercial Bank • Sidian Bank • Cooperative Bank of Kenya • First Community Bank • CIC General Insurance • BOMA Project • Caritas • World Food Programme • County governments (Departments responsible for response to disaster) • National government institutions working in the counties in agricultural sector • Kenya Red Cross Society |
|--|

Annex 6a: Marginal Effects for Droughts and Floods (Non-Finance Coping with Climate Information Index Covariate)

| Variables | <i>P</i> (00) None of formal non- finance or informal non-finance | <i>P</i> (01) Informal non-finance only | <i>P</i> (10) Formal non-finance only | <i>P</i> (11) Formal non- finance and informal non-finance |
|--------------------------------------|--|--|--|--|
| Cluster: Urban | -0.0165* (0.00977) | -0.272*** (0.0402) | 0.140*** (0.0354) | 0.148*** (0.0503) |
| Household size | -0.000136 (0.000383) | 0.00656 (0.00647) | -0.0185** (0.00940) | 0.0120 (0.0115) |
| No. of household income earners | -0.000185 (0.000811) | 0.0190 (0.0123) | -0.0449* (0.0251) | 0.0261 (0.0274) |
| HH head years of formal education | 0.000193 (0.000250) | 0.000202 (0.00381) | 0.00736 (0.00450) | -0.00776 (0.00615) |
| Age of household head | 3.93e-05 (0.000298) | -0.00283 (0.00486) | 0.00717 (0.00828) | -0.00438 (0.00935) |
| Square of age of household head | -1.29e-06 (2.97e-06) | 1.22e-05 (4.62e-05) | -7.60e-05 (7.79e-05) | 6.51e-05 (8.88e-05) |
| Gender of household head: Male | 0.00140 (0.00176) | 0.0161 (0.0279) | 0.0322 (0.0544) | -0.0497 (0.0591) |
| Semi-arid:10-29% aridity | -0.0140* (0.00830) | -0.427*** (0.0379) | 0.367*** (0.0682) | 0.0739 (0.0725) |
| Semi-arid:30-84% aridity | -0.0140* (0.00834) | -0.430*** (0.0374) | 0.169*** (0.0443) | 0.275*** (0.0511) |
| Arid:85-100% aridity | -0.0140* (0.00834) | -0.430*** (0.0374) | 0.221*** (0.0647) | 0.223*** (0.0703) |
| Information index | -0.00424 (0.00371) | -0.0574 (0.0472) | -0.0570 (0.0427) | 0.119** (0.0583) |
| Observations | 761 | 761 | 761 | 761 |

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Annex 6b: Marginal Effects for Droughts and Floods (Finance and Non-Finance Usage with Climate Information Index Covariate)

| Variables | <i>P</i> (00) None of finance or nonfinance coping mechanisms | <i>P</i> (01) Nonfinance coping mechanisms only | <i>P</i> (10) Finance coping mechanisms only | <i>P</i> (11) Finance and nonfinance coping |
|--------------------------------------|--|---|--|--|
| Cluster: Urban | -0.136*** (0.0301) | -0.0387*** (0.00880) | 0.000943 (0.0103) | 0.174*** (0.0373) |
| Household size | 2.04e-05 (0.00374) | -4.42e-05 (0.00164) | 5.80e-05 (0.00186) | -3.42e-05 (0.00540) |
| No. of household income earners | -0.0238** (0.00989) | -0.000928 (0.00532) | -0.0100* (0.00575) | 0.0348** (0.0142) |
| HH head years of formal education | -0.00427* (0.00219) | -0.00287*** (0.000909) | 0.00116 (0.000969) | 0.00598* (0.00313) |
| Age of household head | 0.00160 (0.00317) | 0.00137 (0.00128) | -0.000765 (0.00160) | -0.00221 (0.00460) |
| Square of age of household head | -7.56e-06 (2.93e-05) | -1.07e-05 (1.14e-05) | 8.28e-06 (1.44e-05) | 1.00e-05 (4.25e-05) |
| Gender of household head: Male | 0.0229 (0.0205) | 0.00233 (0.00970) | 0.00823 (0.0104) | -0.0335 (0.0299) |
| Semi-arid:10-29% aridity | -0.0942** (0.0409) | -0.00399 (0.00957) | -0.0149 (0.0131) | 0.113** (0.0487) |
| Semi-arid:30-84% aridity | -0.214*** (0.0307) | 0.00376 (0.00897) | -0.0427*** (0.0104) | 0.253*** (0.0338) |
| Arid:85-100% aridity | -0.211*** (0.0321) | 0.0108 (0.0188) | -0.0427*** (0.0104) | 0.243*** (0.0386) |
| Information index | -0.0474** (0.0228) | -0.0167 (0.0119) | -0.00373 (0.0152) | 0.0679** (0.0332) |
| Observations | 919 | 919 | 919 | 919 |

Standard errors in parentheses

*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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