Climate Variability and Response Strategies among the Gadamoji Agro-Pastoralists of Marsabit County, Kenya

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Abstract

Climate is perceived to be changing thus calling for understanding of livelihoods strategies to guide in developing climate-resilient livelihoods. This study assess the perception of climate variability, impacts and household response strategies among agro-pastoralists in the period 1998-2012 in Gadamoji division of Marsabit County. Data were collected from 133 households and 3 Focused Groups. Results show that local people are aware of rainfall and temperature variability and its impacts on their livelihoods. Key perceived impacts include increased food insecurity, reduced livestock holdings and increased water shortage. Consequently, most households have adopted response strategies resulting in reduced nature-based livelihoods and increased in alternative non-farm activities. However, these strategies were found to be inadequate and largely pursued in a random manner as well as hampered by challenges ranging from poverty, unreliable climatic information to inadequate knowledge on alternative livelihoods. The study recommends increased awareness on climate variability and support to current and potential livelihoods strategies.

Keywords: Climate variability, perception, livelihoods response strategies

1.0 Background and Context

1.1 Climate Variability and Impacts on Livelihoods

Scientific evidence increasingly suggests that climate is becoming more variable with significant impacts on rural households particularly in sub-Saharan Africa (Cooper *et al.* 2008; IPCC, 2007). The impacts of climate change phenomena are progressively emerging as an unprecedented global challenge to development in general and poverty reduction in particular especially among millions of rural people living in marginal regions with minimal livelihood options (Brown and Crawford, 2008). Numerous studies have shown that as variability in climatic elements increases, the vulnerability of rural livelihoods and the ability of smallholder household's to deal with its shocks and stresses increases (Lioubimtseva *et al.* 2009).This is particularly so among rural households in Kenya who often suffers immense social and economic effects due to effects of climatic condition (Deressa *et al.* 2008). Indeed, in the past two decades, the effects of climate variability on crops and livestock are increasingly blamed for deteriorating livelihoods among most rural areas in Kenya (Mutimba *et al.* 2010; Obando *et al.* 2010).

Given that the climate variability was projected to increase in the coming decades, understanding it was viewed as key to building adaptive capacity of those engaged in climate-based livelihoods (Batisani *et al.* 2010; Lioubimtseva and Henebry, 2009). However, much scientific work on climate variability and change has focused on the global and regional levels than on local context where climate impacts and responses measures are most felt (Deressa *et al.*, 2008). Consequently, awareness on climate variability particularly among the rural folk remains low. Indeed, an opinion poll done in Kenya between 2007 and 2008 shows that over 44% of Kenyans relying on climate sensitive economic sectors have no knowledge of climate change or opportunities in it (Mutimba *et al.* 2010).

1.2 Local perception and Adaptation to Climate varibility

Though knowledge of people's perceptions and adopted adaptation measures were paramount to inform future actions to ameliorate impacts of climate change, this seems to have elicited little interest from researchers going by the number of available literatures on climate change awareness (Bryan *et al.* 2011; Smith *et al.* 2012).

In addition, the link between climate variability and household livelihood responses are largely unexamined yet improving resilience of communities and households to effects of climate change impacts requires understanding of local practices (Smucker and Wisner, 2008). This gap is particularly true in remote localities like Gadamoji division. Indeed, a study on climate shocks done in Marsabit County recommended further inquiry on long-term and site-specific climate effects as well as local perceptions of climate risk (Little *et al.* 2001). There is also increasing recognition that the traditional global study on climate change has fail to address the local impacts and local abilities to adapt to climate change effects with assertion that while climate change is a global phenomenon, adaptation is site-specific issues that require site specific knowledge and experiences. Furthermore, it was recognized that it's not easy to predict household climate change impacts and adaptation strategies at international level due to minimal standard definitions, absence or difficulty to get benchmark data (Deressa *et al.* 2008). Therefore, a strong imperative to understand the actual dynamics of climate change impact and adaptations at the lowest levels of the society, such as households, communities and districts were suggested. There is also an increasing recognition that past policy responses to climate change impacts as well as anticipatory interventions has been based on educated guesses. This makes it imperative to understand the livelihood options available to the poor households as well as how to sustain those livelihoods (Assan *et al.* 2009). There are also growing calls that poverty reduction should prioritize adaptation to climate changes based on local strategies hence need to indentify both emerging and desired livelihoods options at the households' level (Batisani *et al.* 2010).With the projected future climate variability and its impacts on rural livelihoods which in Kenya is estimated to cost 3% of Gross Domestic Product (GDP) per year by 2030, there is also need to develop a menu of livelihood options to serve as a guide for enhancing sustainable households' resilience in the region (Batisani *et al.* 2010). It is against this backdrop that this study was conceived to understand local perceptions of climate variability, document current livelihoods strategies and develop menu of desirable livelihoods options for building sustainable livelihoods resilience in light of future climate variability and changes.

2.0 Methodology

2.1 Study Area

The study was conducted in Gadamoji division of Saku district which lies between Longitudes 37˚ 60'E and 38˚ 2'E and Latitudes 2˚ 15'N and 2˚ 13'N. It has a semi arid climatic condition with an average temperature of 20˚ 5C and biannual rainfall ranges of 700 mm to 2592 mm. Rain falls in April-May (77%) and August-September **(**2**%)** with intermittent period of dry seasons**.** The area was characterized by high poverty level with absolute poverty at 92%, food poverty at 83% and hardcore poverty at 68% of the total population. It was chosen for the study because the inhabitants are agro-pastoral communities who practice climate-based livelihoods (subsistence crop farming and livestock rearing) thus an ideal geographical focus for the study. Indeed, while it used to be a food basket for the region with rain periods that are predictably well-synchronized with planting seasons, it is now infamous for heavy reliance on relief rations (Saku District Development Plan, 2008-2012).

2.2 Research Design

This study used descriptive research design whereby both qualitative and quantitative data was collected and analyzed from a sample of population under study which composed of 3 locations: Dirib Gombo, Badassa and Boru Haro. This design enabled generalizing the findings to a larger population of agropastoralists in Saku district due to its high degree of representation.

Each location represented one stratum hence there were 3 categories of strata. Stratified random sampling procedure was used in selecting the sample population of the study. Based on a rule of thumb that sample size of between 10 and 30 % is a good representation of the target population (Mugenda and Mugenda, 2003), qualitative and quantitative data were collected from a sample size of 10 % from each location. To arrive at exact number of households in each location to be included in the sample, specific number of households per village were divided by the total number of households in the entire sub-location and multiplied by the sample size taken i.e. **V/T×90**; where ***V*** represented number of households in a particular village, and ***T*** represented total number of households in the study area. The number of households in each location included in the sample is shown in table 2.1.

Table 2.1: **Number of Households included in the Sample**

No.	Locations	Total households (T)	Households in the sample (V/T×90)
1	Dirimb Gombo	452	45
2	Badassa	354	35
3	Boru Haro	528	53
	Total Households	**1 334**	**133**

Source: (Kenya National Bureau of Statistics, 2010).

After obtaining the desired household numbers in each stratum, specific households were sampled using random sampling. 133 households comprising of young adults, middle age adults and old ages were interviewed out of the total households' of 1334. 98 % return rate of questionnaires (both closed and open-ended) were achieved. Using interview guides, three Focus Group Discussions (FGDs) involving 33 community leaders who are recognized as repositories of collective local wisdom and historical memory were also done to supplement information from household questionnaires, collect community level adaptation strategies and other social data. Three research assistants who had firsthand knowledge of the area and fluent speakers of local language were trained to help in data collection exercise. Key data collected are on people's perceptions of climate variability and perceived impacts on their livelihoods, households' and community response strategies and possible livelihoods support options. The returned questionnaires were checked for consistency, cleaned, and the useful ones coded and analyzed using descriptive statistics by applying the Statistical Package for Social Science (SPSS V.17.0). The quantitative summary of the findings were presented through percentages, tables, deviation and frequencies.

3.0 Results and Discussion

3.1 Perceptions on Climate Variability and Impacts on Livelihoods

3.1.1 Perceptions on Climate Variability in Gadamoji Division from 1998-2012

Household respondents were asked whether they noticed any change in average temperature and rainfall over the past 15 years (from 1998) preceding the study. 93.7% of the respondents have not only noticed changes in the average temperature and rainfall but also observed that the change had had significant adverse effects on their livelihoods. Analysis of responses by gender shows that 97.8% and 87.9% of males and females respectively reported recognizing changes in the average rainfall and temperature while 2.2% and 12.1% of the males and females had not. The difference in perceptions could be viewed in terms of different roles played by male and female and how climate variability affects them. As a patriarchal society, men are the breadwinner thus prone to climatic effects that particularly affect their roles to provide for the family. Other key climate variability changes noticed include widen rainfall spacing between seasons and shorten rain period, changes in rain onset, cessation period and cycles of failure and overall increase in temperature in the area (97 % of the respondents).

Table 3.1: Perception on Aspects of Climate Variability

Climate aspects	Perceptions	Frequency (F)	% of respondents(n=130)
Rainfall Amounts			
	Increased	10	8%
	Decreased	120	92%
Rainfall Spacing			
	Widened	129	99%
	Narrow	1	1 %
Rainfall Time (Season**)**			
	Shortened	129	99%
	Extended	1	1 %
Rainfall Onset and Cessation			
	Delay onset &Early ends	130	100%
Rainfall Failure			
	Yes	130	100%
Temperature		0	
	Increased	126	97%
	Decreased	4	3 %

In addition to the above, 53% and 19 % of the respondents think rainfall failures and widened rainfall spacing respectively are the main aspects of rainfall variability that had posed great challenges to their livelihood during the study period. On the other hand, 21% of the respondents think shortened rainfall season pose great risk while 7% of the respondents believe any deviation from normal rainfall trends negatively affects their livelihoods as one respondent succinctly summarized; *"When rains don't come, or come too early or late, it spell disaster to us, because we depend on rain for survival'* (Habiba Galgallo, Household interview in Dirib Gombo on 13th December 2012).

The findings shows local people are aware that climate variability are not usual cyclical or seasonal phenomenal. The fact that they can point out key aspects of changing climate factors shows the level of their livelihoods sensitivity to climate. The findings agree with similar studies on perception done in Northern Kenya. A study by Bryan et al (2011) in 13 Arid and Semi Arid divisions in Kenya, for instance, found that an overwhelming majority of farmers (96 % and 91 % n= 710 households) had perceived increased in average temperature and rain variability respectively (Bryan *et al.* 2011).

3.2.2 Perceived Impacts of Climate Variability

79.5% of the respondents reported been very severely affected by the perceived impacts of climate variability on their households sources of income. This shows the level of livelihoods dependency on climatic factors in the division.

Table 3.2: Magnitude of Climate Variability Impacts on Household Income

			Magnitude of Climate Variability on Household Source of Income			
			Very Great Extent	Great Extent	Low Extent	
Gender	Male	Count	82	19	2	103
		% within Gender	79.5	18.2	2.3	100
	Female	Count	21	6	0	27
		% within Gender	79.3	20.7	0	100
Total		Count	103	24	2	130
		% within Gender	79.5	19.2	1.4	100

Furthermore, frequent poor yield from crops (89 %) and reduced or complete loss of livestock holdings due to droughts (90 %) were the main impacts of climate variability indentified by most households during the period under study. Indeed, drought was reported to have blurred social boundaries between wealthy and poor in terms of livestock ownership in the area thus affecting the traditional social safety net of livestock loaning system. A study on Kenya's climate change preparedness and vulnerability done in 2010 agrees with this finding noting that most pastoralists lost more than half of their herds to droughts in 2009 (Mutimba *et al.* 2010).

In addition, 84 % (n=130) of the households' respondents believe climate variability has increased household poverty (increased household inability to meet various domestics and social obligations e.g. paying school fees) while 97 % of the respondents blame increased in food insecurity and dependence on relief foods to effects of climate variability. 68 % of the respondents on other hand believe that climate variability had resulted to acute water shortage and increased household costs (in term of expenditure and time) in accessing water for both livestock and domestic use in the areas. Furthermore, 54 % of the respondents noted decrease and/or disappearance of forage species; a condition blamed for reduced livestock yield and their vulnerability to effects of drought.

Table 3.3: Perceived Impacts of Climate Variability on Livelihoods

Perceived Impacts of Climate Variability in the Period 1998-2011	Male		Female		Total
	Count	% N=97	Count	% N= 33	% N=130
Poor crops yield	88	91	29	87	89
Decrease and/or Loss of Livestock holding	86	89.1	30	91	90
Increased Households Poverty and Social ills	82	84.5	27	82.5	84
Food Insecurity and Dependence Relief	94	96.5	32	97	97
Increase Water shortage and Cost on Water	68	70.2	22	65.4	68
Disappearance of forage species	54	56	17	52	54

A study in Northern Kenya by Obando et al (2009) on climate effects concurs with the above findings and blame climate variability for increase general poverty in the region (Obanda *et al.* 2009). The finding on livestock feeds also matches with a study done in 13 arid and semi-arid divisions in 2011 where 65 % of 710 respondents attribute disappearance of livestock feeds to effects of climate variability (Bryan *et al.* 2011).

3.2.3 Perceived Causes of Climate Variability

A significant number of respondents (76.7%) attribute climate variability to natural causes while to a small proportion (1.2%) it's an expression of divine anger (God annoyance) to men. Mzee Duba Galgallo, an elder from Dirimb Gombo note; "*There are many sinners in our midst and God is punishing us for their sin"*. Key reasons for the perceived divine anger was failure by community elders to appease ancestral spirits and rain gods through practicing traditional rituals. In addition, majority of the respondents (97.7%) believe that climate variability and its impacts will worsen in future. The study therefore note that the increased perception on future risk of climate variability gives an opportunity to capitalize on in designing climate change awareness program as well as draw local attention on building people's adaptive capacities.

3.3 Households Livelihoods Responses

The increasing impacts of climate variability have compelled most households to innovative risk management responses to minimize the effects on their livelihoods strategies ((Lioubimtseva *et al.* 2009). Given that sustainable development and household food security of small-holder farmers depends highly on their ability to cope with risks affecting their livelihood, knowledge of these strategies thus remains critical.

3.3.1 Adjustment to Farming and Livestock Husbandry Practices

Respondents were asked whether they have changed their crop farming and livestock husbandry over the past 15 years preceding the study to cope with effects of climate variability. 97.2% of the respondents (n=130) admitted adjusting their crop farming and livestock rearing practices to a great extent and only 2.8 % adjusted to a low extent. It is however noteworthy that though climate variability was identified as a key contributing factor, combination of multiple factors e.g insecurity and socio-political environment reportedly accelerated the adjustment. The fact that climate variability compelled many households to change their crop farming and animal husbandry practices indicates potential uptake and success of new response strategies in the area. A similar study done in Tharaka on households' responses to drought also found that most households adopted multiple strategies to resist effects of droughts (Smucker *el at*, 2008).

3.3.2 Household Adaptation Strategies to Effects of Climatic Variability

The study found two levels of response strategies adopted over the study period (1998-2012) to adapt to effects of climate variability: households and farm levels.

Key farm-level responses are: changing crop types from traditional staple crops (maize and bean) to more drought resistant crops (87.2 %) notably Khat (mirra) which are said to also fetch good money and less affected by changes in rainfall amount and patterns than like maize and bean (main food crops), reducing farm size (67.1 %), adjusting planting time (75.7 %) and diversifying farm crops (74.4 %). Despite water being a key problem in the area, the study found that water and soil conservation measures at farm level were practiced to a low or no extent by 49.9 % of the respondents. This could be due to low level of awareness and low technical know-how on the conservation measures.

On household-level strategies, 83.2 % of respondents rely on food aid and other external support such as remittances to a very great extent while 65.6 % engage in one or more form of non-farm activities (engage in casual labor, bee keeping or sell of wood products e.g. charcoal, firewood, building poles and local brews) to cope with adverse effects of climate variability. Some of the households which engage in non-agriculture activities either do not have enough livestock to rely on or crop produces to sustain them thereby forced to rely on food aid or engage in sale of labor to meet household needs.

A good proportion of households (62.2 %) practices during and pre-impact saving (reduce amount of meals, eat less preferred food, save money, postpone family social obligation etc) while another 59 % engages in roof rain water harvesting to cope with perennial water shortage. Other responses mentioned include reducing herd number (54.6 %), diversifying herd composition which involve changing stocks to more drought-resistant stocks e.g goats, camels and poultry (54.1 %) and migration of household labour (41.2 %). In addition, providing supplement to livestock feeds (e.g feed livestock with tuber), fodder preservation, engaging in credit from better-offs groups and credit institutions, sale of milk or crop produces and practicing kitchen gardening are some of the strategies which sampled households relied on to adapt to the prevailing climatic cSonditions. Though to a low extent, some livestock based strategies are also practiced. These are: herd splitting, slaughtering of young and old animals and selling livestock to meet basic family needs. Table 3.4 shows analysis of these strategies.

Table 3.4: Adopted Farm and Household-Level Adaptation Strategies

Adaptation Strategies	**Extent of adoption by households (N= 130) Percentage (%)**				
	Very Great Extent	**Great Extent**	**Moderate Extent**	**Low Extent**	**No Extent at All**
Plant Early Maturing and Drought Tolerant Seeds	52.3	29.1	14.0	4.7	0.0
Change Crop Type	87.2	8.1	2.3	1.2	1.2
Adjust Planting Time	22.0	53.7	14.6	9.8%	
Reduce Farm Size	67.1	28.2	2.4	1.2	1.2
Plant Soil Conservation Measures	12.9	15.4	21.8	39.4	10.5
Diversify Crops Type Planted	31.4	43.0	20.9	1.2	3.5
Diversify Herd Composition	54.1	35.9	9.4	1.6	
Herd Splitting and Migration	14.4	17.9	25.1	23.3	19.3
Slaughter Young and Old Animals	1.2	29.8	35.7	20.2	13.1
Reduce Herd Number (Destocking)	54.6	24.7	16.8	2.8	1.1
Supplement Livestock Feeds	11.0	40.2	29.3	11.0	8.5
Fodder Preservation e.g. *Kallo*	23.3	30.2	41.9	3.5	1.2
Sale Livestock	31.4	16.3	24.4	11.6	16.3
Engage in Non-Farm Activities	65.6	15.6	7.8	5.0	14.0
Reliance on Food Aid, remittances and other External Support	82.3	9..8	7.9		
Roof Rain Water Harvesting	59.0	34.9	4.8	1.2	
Credit from Better-offs and local Institutions	39.5	25.6	5.8	12.8	16.3
Household labour Migration	23.5	41.2	27.1	8.2	
Adopt Pre-Impact Saving	62.3	29.5	4.7	3.5	
Sale Milk or Crop Produces	21.9	17.9	7.0	28.6	24.7
Practice Kitchen Gardening	33.3	38.1	27.4	1.2	

In addition to the above households' level strategies, Focused Group discussants indentified community level strategies to adapt to effects of climate variability in the area. These includes soil conservation measures (digging farm trenches) in Badassa, planting of tree nurseries in Dirimb Gombo, emerging village group saving and merry-go rounds initiative in the area, digging and protection of shallow wells in Badassa sub-locations, sinking of community boreholes and excavation of earth dam in Dirimb Gombo.

The fact that all sampled households have adopted autonomous adaptation strategies shows some levels of people's acceptance of the changing climatic situation hence the struggle to live with the effects.

The results also shows that most of the strategies are not pursued alone by households but jointly as a menu of options. This is similar to findings from others studies on household level adaptation done in Kenya. Byran *et al* (2010), for example, identified changing crop type, planting time, diversified income and conservation measures as key form of households' adaptation in a study on adaptation done in 13 arid and semi-arid divisions (Byran *et al.* 2010). A similar study on household response to drought done in 2008 in Tharaka district also identified reliance on food aid, engaging in wage labour and livestock diversification as the main strategy. All these strongly concur with the above findings (Smucker *et al.* 2008).

3.4 Livelihoods Intervention Options

3.4.1 Success of Local Strategies Employed by Local

78.6% of the respondents reported that the strategies adopted by households to mitigate effects of the prevailing climatic conditions have not succeeded while 21.4% disagrees that the strategies has succeeded.

Though the result shows some level of success in household adaptation, interviews with Focused Groups (FGs) attribute the success largely to the supports offered by development partners than as a result of household adaptation. It was also noted that most of these strategies were reactionary largely triggered by unusual climate phenomena than planned measures taken before the onset of predictable climate-induced shocks. However, most activities undertaken by development partners' though not explicitly focused on climate adaptation per se are noted to greatly cushion households either directly or indirectly from adverse effect of climate variability.

3.4.2 Livelihood Options to Mitigate Future Effects

As shown by table 3.5 below, 73 % of the respondents (N=130) would prefer to invest in Small Scale Irrigation, 63.4 % would like to engage in non-farm income activities while 63.4 % would like to start new or expand existing home-based small trade. 77.6 % of the respondents would like to diversify their stocks to goats and camel citing their ability to withstand harsh climatic and environmental conditions. Other options preferred by respondents to a great extent include engaging in agro-forestry and Tree Farming (40%), joining social groups activities (52.4%), investing in livestock and crop insurance premium (40.2%), intensifying domestic water harvesting and storage measures (54.9%), adopting households planning based on climatic information (48.8%), seeking awareness on climatic variability and its impact (58.8%) as well as technical advice on good agronomics practices for sustainable farming.

Table 3.5: Key Livelihood Options to Mitigate Future Effects

Future livelihood options	**Level of Adoption N= 133, Percentage (%)**				
	Very Great Extent	**Great Extent**	**Moderate Extent**	**Low Extent**	**No Extent at All**
Start Small Scale Irrigation	73	31.3	3.3	2.4	
Practice agro-Forestry	40.	37	18.5	2.5	1.2
Engage in Non-Farm Income Activities	63.4	25.6	6.1	1.2	3.7
Start or Expand Petty Trade	63.4	26.9	4.8	2.4	2.5
Join or Practice in Local Groups	52.4	31.7	7.3	8.5	
Invest in Livestock and Crop Insurance	39.0	40.2	9.8	9.8	1.2
Intensify Water Harvesting and Storage Measures	54.9	30.5	9.8	4.9	
Plan Based on Early Warning Information	48.8	29.3	17.1	4.9	
Adopt Conservation Measures and Technical Advice Agronomics Practices	29.3	43.9	15.9	9.8	1.2
Seek Awareness on Climatic Variability Impact	58.8	33.8	3.8	2.5	1.2
Diversify herd composition	77.6	19.1	3.3		

Finally, respondents were asked to state key constrains they would anticipate in adopting the above desired strategies to mitigate future effects of climatic variability at households' levels.

89 % of the respondents noted poverty and lack of capital to invest in climate-resilient livelihoods as the barrier, 84 % mentioned climate uncertainty and lack of reliable climate information, 73 % mentioned inadequate knowledge on other livelihoods while 59 % think ethnic conflicts would be the key barrier.

The analysis shows that majority of the respondents view poverty and climate uncertainty as the key barrier to future adaptation. While the desire for climate information demonstrates the zeal of most households to struggling live with climate change and its effects, some Focused Groups discussants were skeptical of their continued ability to manage growing effects of climate variability without external supports to strengthen their resilience either collectively or individually.

4.0 Conclusion and Recomendations

4.1 Conclusion

While this study shows a great sense of awareness on climate variability and its impacts among local population as well as indicate their strong intention to ameliorate adverse effects of climate variability, the autonomous adaptation strategies adopted by most households are inadequate and ineffective in light of increasing effects of future variability. The combined effects of climate unpredictability, current constraints on adaption strategies and lack of climate information at the local level further accelerate livelihood vulnerability to continued climatic shocks. This calls for strengthening current livelihoods strategies which are acceptable both socially and economically based on credible, accessible and client-oriented climate information. This will help to reduce current livelihoods vulnerability and build future resilience. Indeed, building on existing strategies that are within and outside agro-pastoralist livelihood portfolio will make local population active agents in transforming their life than passive recipients of livelihoods support initiatives.

4.2 Recommendations

Based on the research objectives and above findings, the following key recommendations were made:

i. Mainstream climate change at all levels through working with policy makers, development agencies, research institutions, County government and the media.
ii. Sensitize communities to understand their levels of vulnerability and design sustainable adaptation action plans. This can be done through adopting Community Managed Disaster Risk Reduction (CMDRR) model.
iii. Invest to generate and disseminate in understandable format client-oriented climate information to help households make informed decisions. This should be accompanied by relevant extension services e.g. on crops, livestock and menus of viable households' options.
iv. Initiate focused, institutionalized and collaborative framework (e.g. public-private partnership) to strengthen adaptive capacity of households.
v. Increase access to climate information, financial services, levels of literacy and improve social infrastructures to build local adaptive capacities in the division.
vi. Undertake analysis of both positive and negative impacts of climate variability in financial or agricultural terms against the meteorological data as well as variables and roles of institutions that influence or determine rural households' decision to adopt certain response strategies to deepen understanding on relationship between climate variability and rural livelihoods.

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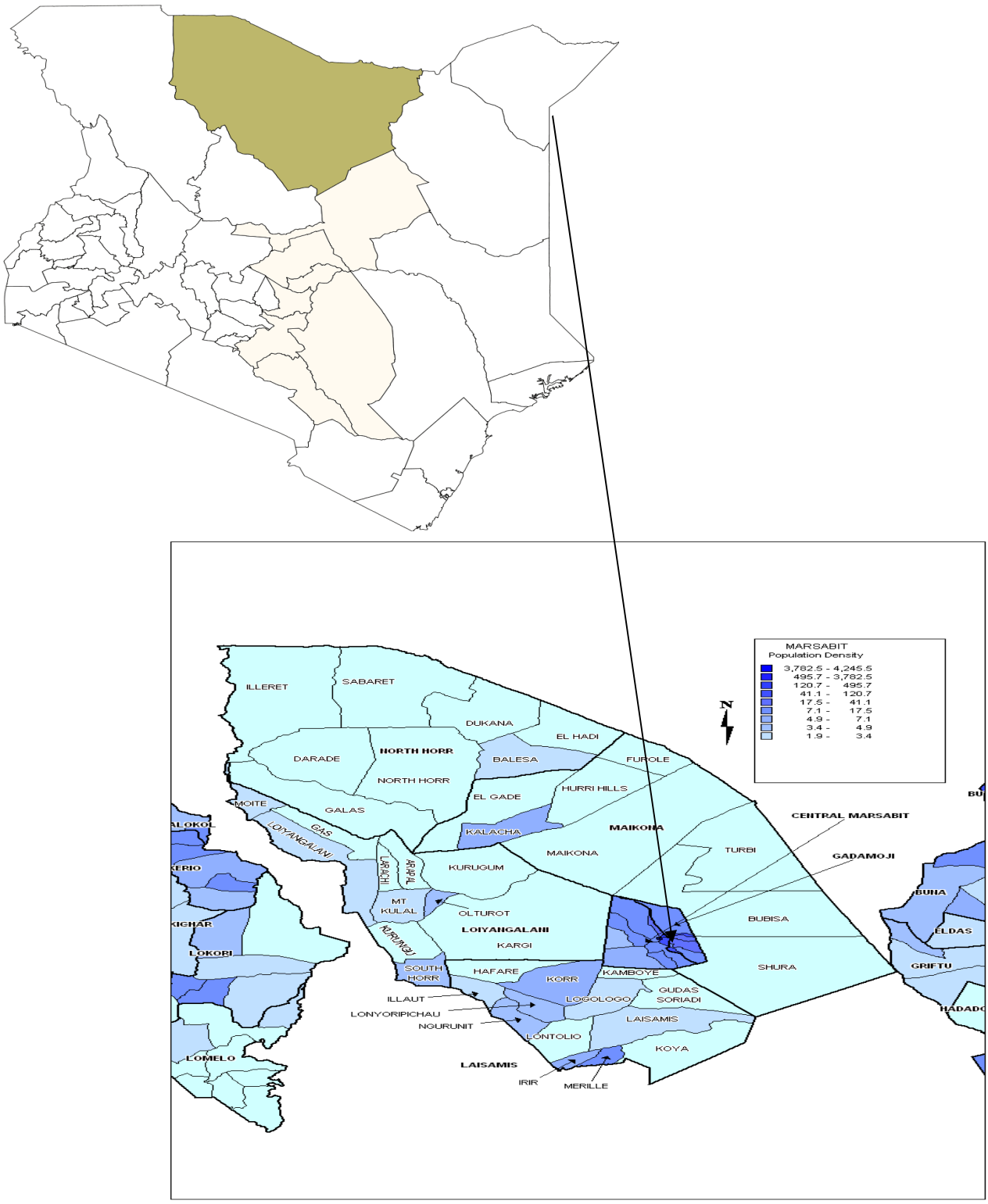
Appendix 1: Map of the Study Area



Source: Saku District Development Plan, 2008-2012.