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Epiphany of Drought-Induced Livelihood Diversification among the Semi-Arid Land Populace of Kenya: A Case of the Kyatune-Ikanga Ward in Kitui County, Kenya

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A B S T R A C T

This study looks at how the inhabitants of the Ikanga-Kyatune Ward in the semi-arid Kitui County, Kenya adapt to the increasing frequency and intensity of droughts with a core concern on the diversification measures taken by the people for their lives and livelihoods sustenance. Using a mixed methodology to gather data from both household surveys (n=55) and key informants, the study findings show that the local people have adapted to droughts through multiple strategies aimed at diversifying sources of food and income to reduce the negative impacts of drought. On the whole, the data shows that in over 80% of households, crops and livestock diversification is still the most commonly used forms of diversification. The agro-pastoralism presents significant risks during prolonged drought periods which are characterized by famine. Comparatively, non-agricultural diversification methods yield consistent, though lower, levels of profits for diversifying families. Statistical analysis confirmed that there is a statistically significant positive correlation between diversification as measured by family income stability and household income stability ($r=0.994$, $p<0.001$). Although most (75%) of those surveyed believe that diversifying their livelihood reduces their risk, there are numerous barriers limiting their ability to do so, such as poor market access, environmental destruction and insufficient infrastructure and financial services. Suggested methods to support improved resiliency building against drought include utilizing climate-smart practices within agriculture, developing improved market access for value-added agricultural products, formalizing support to develop and improve non-farm businesses, and promoting gender-sensitive climate resilience policies through collaborative partnerships at both local and national levels.

Keywords: Adaptation, Diversification, Resilience, Impacts, Vulnerability, Livelihood.

1.0 Introduction

When considering the effects of changing weather patterns in the semi-arid lands of eastern Kenya, the experiences of communities within Kitui County exemplify the climatic vulnerabilities faced by those occupying Kenya's semi-arid lands. Traditionally, the residents have been dependent upon subsistence agriculture based largely upon rainfall dependent crop growing and livestock production. The practice faces an

increasing threat from the rising frequency and severity of climatic events resulting from natural and anthropogenic climate change (IPCC, 2021). The resultant environmental precariousness is much more than an ecological issue, manifested in profound human implications that erode food security, economic viability, and human interactions.

Affected communities respond with actions to cope by restructuring their economic base through strategic configurations of their working capacity.

Livelihood diversification approach is central which involves creating a portfolio of on-farm, off-farm, and non-farm activities designed to allow people the ability to spread risk, achieve a more stable consumption level, and establish a buffer against unexpected events caused by climate change (Ellis, 2000; Scoones, 1998).

As a global adaptation strategy, diversification is critical in dryland ecosystems. However, the specific characteristics, effectiveness, and sustainability of diversification vary widely in each specific context.

A large knowledge gap currently exists regarding the differences in droughts resiliency of the various options available to households to cope with droughts, specifically how options allow households to adapt to changing conditions, and how they serve to reduce adverse impacts of droughts on household wellbeing (Ifejika Speranza, *et al.,* 2014).

Additionally, structural barriers such as limited market access, inadequate infrastructure, and gender inequalities) limit the potential of local solutions (Akoth, 2022; Kamau, *et al.,* 2021). As a result, this study provides evidence-based ways that people adapt to diversify their livelihoods through three primary objectives through 1) identifying the adaptive livelihood diversifications and practices being utilized; 2) evaluating how resilient the adaptive livelihood diversifications are to drought; and 3) assessing how effective the adaptive livelihood diversifications are at reducing or mitigating the multifaceted impacts of drought.

The research aimed to produce insights that would be used by researchers, agencies and policymakers in order to develop and implement participatory drought adaptation policies that are more equitable and responsive in the semi-arid regions.

2.0 Materials and Methods

2.1 Location of Study

The choice to study Ikanga-Kyatune Ward was intentional because the region represents many of the socio-ecological challenges and responses that characterize the semi-arid lands of Kenya. The area is reliant on natural resource-based systems that are subject to a significant degree of vulnerability due to existing structural socio-economic constraints. The long-standing challenges presented by recurrent drought cycles show patterns of distress and diversification into some unsustainable livelihoods, such as charcoal burning, and proactive adaptation through climate-smart agriculture and small businesses (Njuguna and Kange'the, 2019). The area is located in the semi-arid Agro-ecological Zone (AEZ) and is consequently very low and highly variable in rainfall (Jaetzold, *et al.,* 2012). It experiences a bimodal rainfall cycle with the long rainy season (March-May) and the short rainy season (October - December) however, there are usually many occasions when there is little to no precipitation during both rainy seasons and/or it comes in heavy erosive downpours, annual average rainfall in Kitui County is between 500mm to 750mm, which is marginally viable for rain-fed agriculture (Kitui County Government, 2022). The land is mostly rolling hills with sandy-loam soils that are well drained and have a low level of fertility. Because of their low level of natural fertility, sandy-loam soils are easily washed away during heavy rains and dry out during prolonged periods of drought (Mbuvi, 2016). Continued cycles of drought caused by climate change are due to climate change and are considered the primary cause of chronic water shortages; crop loss; and declining pastures (IPCC, 2021).

Most of the people in the Ward belong to the Kamba community whose relationships, indigenous knowledge systems and cultural practices are intimately tied to the surrounding environment (Mbiti, 2020). The bulk of the residents live in rural areas and their homes are distributed throughout the land. Household economies are primarily agricultural with most farmers growing subsistence crops such as maize, beans, pigeon peas and millet, and raising livestock on a small scale that comprises goats, cattle, and chickens (KNBS, 2019, County Government of Kitui, 2022). But the agricultural economy of the people has become increasingly unsustainable because of climate changes, making the people live in persistent vulnerability. The lack of access

to appropriate and adequate water resources, health care, and education continues to limit the development of the inhabitant human capital. Infrastructure, specifically all-weather roads and reliable electricity, are poorly developed, which leads to limited market access, reduced viability of non-farm businesses, and limited access to information and technology.

2.2 Research Design

The study used a mixed-methods design to collect quantitative and qualitative data to allow examination of the diversification measures in response to drought. The approach enabled triangulation and generation of a richer understanding of the research problem (Creswell & Plano Clark, 2018). Quantitative data provided breadth of information through statistical analyses and pattern identification, qualitative data also provided contextualization in order to explain the numerical findings.

2.3 Sampling Strategy

Stratified Random Sampling technique was used to choose 55 households of different socioeconomic traits for the study. 15 key informants comprising of local leaders and extension officers formed the target group. The key informants were purposively selected according to their knowledge and experience in drought management.

2.4 Institutional linkages to livelihoods diversification

The study findings show that the resident communities develop and apply drought adaptation measures based on local agency, culture, and knowledge. The livelihood diversification is influenced by a combination of formal and informal institutional arrangements, resulting in varied livelihood strategies. At the formal level, the County Government of Kitui presents the main governing body (CIDP, 2022). Several national agencies, including the National Drought Management Authority (NDMA) also support drought monitoring and response efforts in this area. Many NGOs and faith-based organizations are also providing drought response support to the community through interventions related to food security, water harvesting and sustainable agricultural development (Kilonzo, *et al.,* 2021). The community has established a number of informal systems to share risk and pool resources through local cooperatives and Community-Based Organizations (CBOs) which are vital in facilitating community mobilization of collective action during times of crisis (Mwangi, *et al.,* 2019). The interaction and at times, disconnection, between the two types of institutions semi-structure the degree of success or failure of diversification efforts.

2.5 Data Collection Techniques and Instruments

In November 2024, semi-structured questionnaires were administered to 55 heads of households seeking demographic data, income sources, effects of drought to households in social, economic and environmental terms and, response strategies to drought and their effectiveness. Key Informant Interviews (KIIs) also employed semi-structured questionnaires which served an additional function by providing triangulation and context to the quantitative data collected through household surveys. Qualitative interviews conducted with experts provided insight into the larger institutional and policy framework that governs the drought related livelihood options within the ward, as well as provide insights into community-wide climate resilience challenges, innovations, and adaptive responses, which may not have been fully captured in the quantitative data of the household survey.

2.6 Data Analysis

The analysis of qualitative and quantitative data was an interrelated and convergent process of synthesizing quantitative and qualitative findings and data sets. Quantitative data from the 55 household surveys were processed through a data cleaning and coding process prior to being analyzed using SPSS in order to assure data accuracy and enable to robust analysis. Quantitative analysis used descriptive and inferential statistics as a means of addressing research objectives. Descriptive statistics including frequency counts and percentages were generated for each livelihood practice, distribution of drought impact across different domains and respondent perceptions of the effectiveness of diversification as a resilience strategy by presenting a visual summary of the prevalence of livelihood practice in communities through the development of Figures and Tables. In order to gain a more in-depth understanding of the relationships, Inferential Statistics (Pearson correlation) was carried out using the following equation.

$$r = \frac{n\sum(XY) - (\sum X)(\sum Y)}{\sqrt{[n\sum X^2 - (\sum X)^2][n\sum Y^2 - (\sum Y)^2]}}$$

Where:
r =Correlation coefficient
X- Dependent variable (Climate Resilience Score),
Y- Independent variable (access to Finance)
n -Total number of values/variables

A Multiple Linear Regression Analysis was also completed to quantify how much influence the three major Independent variables (number of diversified activities X_1, access to Finance X_2 and education X_3) had on the composite dependent variable (Climate Resilience Score Y) using the following equation.

$$Y = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \varepsilon$$

Where:
Y = Climate Resilience Score
X_1 = Engagement in diversified livelihood activities
X_2 = Access to financial services
X_3 = Level of education
ε = Error term

Qualitative data collected through Key Informant Interviews was transcribed and subjected to Thematic Analysis, following the guidelines set forth by Braun and Clarke (2006).

3.0 Results and Discussion

3.1 Effects of Drought Impacts

The study established that 10 respondents (18%) experienced negative socio-economic impacts of drought, characterized by livelihood thefts and insecurity at home with migrations, poor pays for casual labor, prices of commodities going up making them unaffordable and livestock purchased at poor prices (Figure 1). 15% of the respondents reported household disruptions. With the male gender moving out in search of income. Failure to secure necessities to bring back home result in disharmony at the households. Female headed households are hit more by droughts compared to male headed households because they have no opportunity to move out and look for alternative livelihoods. People living with disability are negatively affected negatively by drought because of being left unattended as their caretakers go to look for income. Absenteeism from school or altogether dropping out from school dropouts was reported in 13% of the households with 5% of the households experiencing children ending up in child labor. Insecurity and social morality issues were experienced by 16% of the respondents. The impacts included increased immoral activities leading to early pregnancies and marriages and, women and girls engaging in adultery for money. Walking long distances to fetch water that rise from 2 to 10 km, crop failure, destruction of stored food by weevils, and inadequate livestock feeds were cited as major negative impacts in 16% of the households.

a) Livelihood Diversification Strategies

The study established that the inhabitants of the Kyatiune-Ikanga Ward employ diverse strategies to cope with drought (Table 1). The drought episodes are a major risk for the rain-fed agro pastoralism that characterize the area. All respondents, FGDs and extension services staff are in agreement that diversifying livelihoods is a critical strategy for coping with drought because it reduces vulnerability to drought shocks, provides alternative income sources when primary ones fail, and ultimately builds household and community resilience. In essence, livelihood diversification is found to be a proactive and essential strategy that transforms households from being merely victims of environmental stress to being more robust, self-reliant, and sustainable in the face of climate variability diversified portfolio offers greater flexibility to switch between activities as environmental and economic conditions change. This can involve adopting new, more drought-resilient practices like growing drought-tolerant crop varieties, using water-saving technologies, or engaging in non-agricultural enterprises like trade or casual labor.

Over-reliance on a single, vulnerable natural resource such as local rangeland pasture has been seen to lead to environmental degradation, which exacerbates the effects of drought. Diversification, such as moving into fodder production or other enterprises helps to reduce the pressure. The key reasons for livelihood diversification include risk reduction, income stability and security, asset protection and accumulation, enhanced purchasing power, flexibility and adaptability and, reduced pressure on natural resources. By engaging in multiple activities with negatively or weakly correlated returns, households

can spread production and financial risk. If one income stream is affected by drought, others may remain viable. Having diverse income sources is found by 84% of households to provide a more reliable financial flow, which helps smooth consumption and cover essential needs like food, school fees, and medical treatment, even during a crisis. Non-farm income, are in particular a crucial supplement or replacement when agricultural activities are seasonal or fail due to lack of rain. Diversification helps prevent the forced sale of productive assets like breeding livestock or land at low prices during a drought in exchange for immediate food as indicated by 65% of the households. It allows households in asset protection and accumulation through build of savings and accumulation of capital, which serves as an insurance buffer against future shocks. Income from diversified activities increases a household's purchasing power, allowing them to buy food and other necessary items from markets when their own production is insufficient.

The respondents identified inadequate funding, lowered market accessibility and the erratic weather patterns as the challenges faced while diversifying to different livelihoods. Involvement of the civil society, faith and community-based organizations (CBOs) and cooperatives face budgetary limitations and are not able to meet demand. The non-agricultural activities that include small enterprises and temporary work which are less dependent on weather face the challenge of options being fewer, the type of the work and who can perform it, as well as little pay, giving them moderate resilience. Migration could be short or long term and normally leads to household disruptions and reliance on outside labor markets.

b) Resilience of adaptive livelihood diversifications strategies

Table 2 presents the reasons as to why livelihood diversification is found to be an absolute necessity in the semi-arid areas. In the study, FGGs and key informants were in agreement that livelihood diversification strategies significantly enhance household and community resilience to drought. When well-supported by a conducive environment of physical, financial, and social capital, the diversification strategies are highly resilient and essential for mitigating the impacts of drought. Over 70% of the key informants add that the strategies are however not standalone solutions and must be integrated with broader policy and institutional support to be truly effective. They advise that no single strategy is universally optimal and, the success of livelihoods diversification depends heavily on the local context, including access to markets, credit, education, infrastructure, and available natural resources like water and pastures which the semi-arid are limited in, with resultant effects being setbacks one diminishes take place.

Livelihood diversification strategies for drought management in semi-arid lands involve shifting from solely agro pastoralism to mixed income sources like small businesses, casual labor alongside adapting agriculture with drought-tolerant crops, irrigation, and soil conservation. Key approaches include intra-household changes and community-level efforts to build resilience against climate shocks, reducing reliance on single, climate-vulnerable sectors. By combining strategies, households build a diverse portfolio of activities, reducing vulnerability to droughts and climate shocks, ensuring food security, and creating more resilient livelihoods in semi-arid region.

68% of households do crop diversification that encompass planting drought-tolerant, short-maturing varieties such as millet and sorghum. 37% of the households change to enhanced irrigation activities that make use of the seasonal rivers and shallow wells on farm plots while 25% adapt rainwater harvesting through water pans, ponds, and soil-water conservation. Close to 75% of the households have deliberately shifted to more resilient animals like the gala goats and boran cows to diversify herds. Traditional food preservation measures through salting and drying meat to store surplus are in 28% of households. Regenerative activities are manifested in poultry, apiculture, horticulture and, agro-forestry.

The study found that non-farm and off-farm activities for income diversification attract the largest (96%) of the households. Micro-enterprises thrive through small businesses, petty trade, woodwork, pottery, local beverages. Others include transport services offered through motorcycles, wood and charcoal sales. Extractives are observed through charcoal making and brick making. Seasonal out-migration for wage labor is witnessed in more than 80% of the households.

Household and community resilience is realized through education and skills acquisition by household members. Investing in education to enhance adaptive capacity and

open non-farm opportunities is found in about 60% of the households. Adaptive and community strategies encompass information access and use. Utilizing seasonal forecasts and drought early warning systems by 29% of the households characterize the strategy. 46% of the households use indigenous weather forecast knowledge while 25% use a merger of the two knowledge systems. 63% of the households report adjusting their planting dates and crop patterns based on rainfall. Strengthening social networks and promoting collective action for resource management is recognized to be a crucial asset in sharing the dividends of drought.

The resilience of diversification strategies is strengthened by several supporting factors. Access to credit services, savings accounts, irrigation technologies, and drought-tolerant seed varieties are collectively identified by 80% of the households and 90% of the key informants as crucial for enabling households to diversify effectively and build assets. 70% of the key informants report having realized that the low information access and education levels limits access to the benefits, consequently advocating for acquisition of education and skills. They indicate that higher education levels and vocational training to have capacity to increase the likelihood of successful diversification into non-farm activities, which often provide more stable income streams less dependent on climate conditions. For this to be sustained, the key informants advise on having effective local institutions, extension services, and early warning systems to play the vital role of providing timely information and support. About 70% of the households feel that the community is progressing more towards individualism that is diverting them from communal approach to resources protection and use. This is noted to have been particularly beneficial in droughts management. Strong community networks and social safety nets such as traditional mutual support systems help households manage risk and recover from shocks by facilitating resource sharing and collective action. It is therefore vouched for as a strategy to alleviate drought effect.

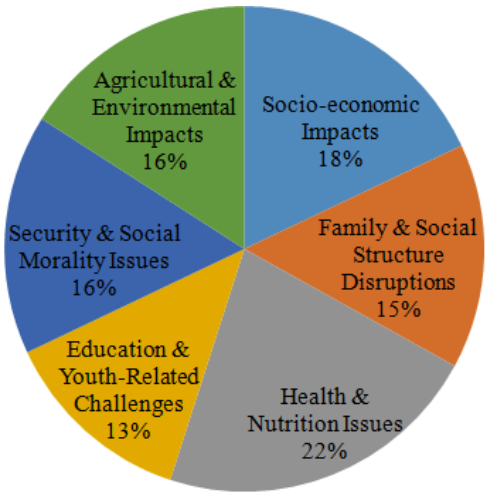
To determine how various factors influencing climate resilience, a multiple regression model was employed (Table 3). The findings show that households that involve in a variety of livelihood practices and have access to financial services are more resilient to climate-related effects.

Households rate agro pastoralism and crop growing as the most (75%) resilient form of livelihoods diversification option (Table 4). This is despite the fact that it faces numerous challenges of damaged grasslands, little or no food for people and livestock, water scarcity and livestock diseases that reduces its efficacy particularly during times of severe drought. The rating is largely based on the fact that it sustains household structures and gives the opportunity to prepare the family land for future droughts management. Given the appropriate knowledge and skills, the majority of the people are in favor of investing on land use activities. The non-agricultural activities that include small enterprises and temporary work are less dependent on weather are more dependable in drought times, supporting 60% of the households. Migration, though effective is reputed to disrupt the family setting. and participation of community-based organizations offer the least resilience capacity. The strategy of relying on community-based organization is rated the least (35%), the reason provided being the institutions unpredictability and lack of transparency in their support.

c) Effectiveness of adaptive livelihood diversifications

Most (92%) of the households report that livelihood diversification strategies are highly effective in enhancing household resilience and reducing vulnerability to drought (Table 5). The alternative income sources and buffering activities against drought-related shocks help households maintain food security and economic stability when traditional, climate-sensitive deeds like rain-fed plant growing and livestock keeping fail. For sustainable effectiveness, FGDs and key informants emphasize the need to appropriately support and tailor livelihood diversification strategies to local conditions in order to capably build household and community resilience to drought in semi-arid regions. Household responses show that the benefits reaped from the effectiveness of the livelihoods include risk reduction, income stabilization, poverty alleviation and enhanced adaptive capacity Diversification, particularly into non-farm activities, reduces dependence on single, drought-vulnerable income streams, thereby spreading risk. Income streams such as petty trade, wage labor and remittances increases purchasing power for food and essential farm inputs during drought periods, which helps smooth consumption and avoid distress sales of assets. Majority (70%) of the households report that engaging in diversified livelihood strategies makes them experience lower levels of poverty compared to non-diversified households.

Fig.1 Impacts of droughts



(Source; Kasuki, 2024)

Table.1 Livelihoods Diversification Strategies

Strategy		[N=55]
1.	Crops Adaptations	36
2.	Livestock Adaptations	42
3.	Off-Farm Activities	53
4.	Community Resilience	33
5.	Household Resilience	33

Table.2 Motives for Households Livelihood Diversification

Reason		[N=55]
1	risk reduction	55
2	income stability and security	46
3	asset protection and accumulation	36
4	enhance purchasing power	33
5	flexibility and adaptability	36
6	reduce pressure on natural resources	23

Table.3 Multiple Regression Results

Independent Variable	Coefficient (β)	p-value
Engagement in diversified livelihoods	0.47	0.002
Access to financial services	0.42	0.009
Level of education	0.31	0.018

Table.4 Livelihoods Diversification Strategies Resilience

Diversification strategy		Resilience Level	% [N=55]
1	Crop and livestock	Most resilient	75
2	Crop cultivation		
3	Non-farm activities	Medium resilient	60
4	Small scale businesses		
5	Urban migration	Least resilient	35
6	Participation in CBOs and cooperatives		

Table.5 Accrued Benefits

Benefits		[N=55]
1.	Risk Reduction,	49
2.	Income Stabilization,	42
3.	Poverty Alleviation,,	39
4.	Enhanced Adaptive Capacity	51

Table.6 Diversified livelihoods effectiveness rating

Extent of Effectiveness	Respondents (N=55)	Percentage (%)
Very High Extent	41	75
High Extent	28	50
Moderate Extent	19	35
Low Extent	8	15

The income and capital accumulated through diversification allows the households to invest in long-term adaptation measures, such as purchasing drought-tolerant seeds, accessing irrigation, or joining community savings groups.

To examine the relationship between diversification strategies and household income stability, Pearson correlation analysis was employed. The correlation between diversification of livelihoods and household income are highly positively, as prescribed by the Pearson correlation coefficient (r) = 0.994 and ($p < 0.001$) meaning the correlation is highly statistically significant. This means that there is a very strong and reliable relationship between livelihood diversification and household income. The results also indicated that households with higher education levels tend to have a variety of revenue-generating activities and depend less on rain-fed agriculture.

Assessments by key informants prescribe effective livelihood diversification in semi-arid areas to involve a mix of on-farm and non-farm activities. Agricultural adaptation involves crop and livestock diversification that invites integrating different crop species and livestock types which are more drought-resilient. Drought-smart practices that include utilizing irrigation infrastructure, water harvesting schemes, and improved agricultural inputs are crucial complements. Engagement in off-farm and non-farm jobs activities like agro-processing and small-scale trade provides reliable income streams less directly tied to rainfall variability.

While effective, challenges exist. The success of the livelihood diversification heavily depends on contextual factors. Poorer households often face barriers to engaging in high-return diversification due to a lack of initial capital, education, or market access, often being pushed into low-return, unsustainable activities like charcoal burning. Some alternative coping mechanisms, such as charcoal burning and brick making unsustainably exploit natural resources, consequently degrading the environment, exacerbating future vulnerability. Key informants inform that livelihood diversification is most

effective when supported by institutional frameworks, improved infrastructure, and access to relevant information and training. Table 6 shows the rating of effectiveness of the diversification strategies by households. The biggest majority (75%) indelicate that diversification significantly reduces vulnerability to drought, as it ensures multiple sources of income and food security.

3.2 Institutional linkages to livelihoods diversification

The study findings show that the resident communities develop and apply drought adaptation measures based on local agency, culture, and knowledge. The livelihood diversification is influenced by a combination of formal and informal institutional arrangements, resulting in varied livelihood strategies. At the formal level, the County Government of Kitui presents the main governing body (CIDP, 2022). Several national agencies, including the National Drought Management Authority (NDMA) also support drought monitoring and response efforts in this area. Many NGOs and faith-based organizations are also providing drought response support to the community through interventions related to food security, water harvesting and sustainable agricultural development (Kilonzo, *et al.,* 2021). The community has established a number of informal systems to share risk and pool resources through local cooperatives and Community-Based Organizations (CBOs) which are vital in facilitating community mobilization of collective action during times of crisis (Mwangi, *et al.,* 2019). The interaction and at times, disconnection, between the two types of institutions semi-structure the degree of success or failure of diversification efforts.

4.0 Conclusion

In the semi-arid lands, the efficacy of the choice of livelihood diversification faces various social, economic and environmental challenges. Each option presents its own unique challenges. The unpredictability of drought occurrences and conditions manifest as the highest drawback in building reliable households and community resilience. This justifies the need for a multiplicity in diversifications. However, diversification options are limited by low levels in information access, knowledge and skills. Consequently, emphasis is required to educate the people on reducing vulnerability through skills and knowledge acquisition. Value addition on production and using technology in marketing is prescribed, whose sustainability will depend on the government, community and other stakeholders congregating to provide conducive environments that need to include addressing infrastructure improvement. Provision of drought management through livelihoods diversification options and technical support is of absolute necessity. In the process, combining indigenous knowledge with contemporary practices to improve drought coping systems should be embraced as part of cultivating sustainability. Nature based solutions in water harvesting, apiculture and sustainable harvesting the forests and the seasonal rivers are recommended for embracement, coupled with support to formation of gender sensitive interest groups, cooperatives and market linkages to allow people leverage their negotiating power to ensure receiving fair market prices for products.

4.1 Conflict of Interest

The authors declare no competing interests.

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