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Identifying drivers of household coping strategies to multiple climatic hazards in Western Uganda: implications for adapting to future climate change

Abstract

This paper investigates what drives household coping strategies in rural Uganda under different climatic hazards. Rural households in sub-Saharan Africa draw on various coping strategies to reduce the impact of climatic hazards on their livelihoods. Research to date provides only limited understanding of how the coping strategy portfolio of households' changes depending on the climatic stress. Using empirical data from Uganda, this research contributes to this gap by 1) exploring how household coping strategy relates to household characteristics and livelihood activity; and 2) how these coping strategies vary depending on the hazard. Coping strategy is found to be hazard specific for households that lack market-orientated activities, whereas those with market-access rely on economic activities regardless of hazard. The implications that choice of coping strategy has on future adaptation are discussed. To maintain and improve the livelihoods and coping strategies of those most vulnerable to climatic variability and change, policies that advocate diversification away from a sole reliance on customary activities need to recognise the level and opportunity for market-based activities. These interventions must account for different sensitivities to different hazards as well as the homogeneity of the community in order to effectively support rural communities to cope with climate variability.

Keywords:

Coping strategies; climate variability; livelihoods; extreme events; Uganda

1 Introduction

Rural communities across the developing world use various coping strategies in response to poverty, food insecurity, conflict as well as environmental stresses; all challenges which are compounded by climate change and variability. The Intergovernmental Panel on Climate Change reports that parts of Africa may experience longer and more intense droughts, with other areas experiencing more erratic rainfall (IPCC 2012). As a result, communities may experience environmental stressors that are beyond their previous understanding (Adger *et al.* 2003). Amongst the most vulnerable will be communities who depend on rain-fed agriculture and natural resource related activities. These communities will not only be impacted by changes in mean climate, but may experience greater impact from climate variability, including extreme events (Smit and Pilifosova 2001).

It is argued that better understanding farmers' adaptation processes will enable more targeted and appropriate climate adaptation policies (Adger and Vincent 2005). Earlier studies have examined slow-onset climatic hazards such as droughts (Roncoli *et al.* 2001), as well as household responses to rapid-onset events such as floods (Motsholapheko *et al.* 2011), showing the importance of short-term labour switching, as well as longer term diversification. The majority of these studies focus on one stress, whilst a few have addressed strategies used to cope with multiple stresses (Osbahr *et al.* 2008; Quinn *et al.* 2011) with the latter remaining focused on the variety of strategies used. This paper provides empirical evidence that helps attribute preferred strategies to specific stresses, with a focus on understanding the factors that shape this choice of strategy.

Different hazards cause different impacts. Therefore the association of household responses with hazard must be better understood to target policy and resource allocation. Where studies have previously tried to attribute strategies to stress, for example such as Hisali *et al.* (2011) in Uganda, they have done so at a national level which has not accounted for the impact of local contexts. Place-based studies help to understand the role of context specific factors (Eriksen *et al.* 2005) which must be accounted for if associated policies are to benefit those they target. For this reason, this paper examines drivers of household coping strategies to floods and droughts in two communities in rural Uganda. The specific objectives are:

1) to identify the coping strategies used by households in response to floods and droughts;
2) to examine the factors that influence choice of strategy;
3) to explore what this means for adaptation policy in rural communities.

Uganda is typical of many sub-Saharan countries due to the predicted increase in more erratic rainfall episodes (IPCC 2012) as well as the dependence of many livelihoods on natural resource activities: over 90% of the population depend on rain-fed agriculture, with fishing the second most important labour employment sector (UBOS 2009). Uganda thus provides a suitable case-study context in which the drivers of choice of coping strategy to climatic hazards can be explored. Empirical data is collected from two communities, both having experienced multiple floods and droughts in the past two decades: one is a traditional subsistence agricultural community, the other an inland fishing community. We used a mixed-methods approach with quantitative household surveys and qualitative interviews to identify factors that influence households' responses to climate variability and change. Both the climatic hazards of floods and droughts are related to extremes in precipitation (IPCC 2012), with drought commonly defined as "a period of abnormal dryness" (IPCC 2012, p558) and floods recognised as "the accumulation of water over areas not normally submerged" (IPCC 2012, p559). Households currently cope with floods and droughts as part of

normal seasonal variability in weather. Climate projections for Uganda include both increased and decreased rainfall (McSweeney *et al.* 2010), and therefore investigating both flood and drought events is important given future uncertainty.

Our results contribute towards understanding how adaptation and development policy can better support rural communities facing multiple climatic stresses. Adaptation research has focused on the marginal or most vulnerable, with targeted policy recommendations for coping strategies to (general or a single specific) stress. We identify that the levels of market access affect whether households vary coping strategy by hazard: the ability to cope with one climatic hazard does not provide assurance that the same coping strategy will be successful with other hazards. Yet policy recommendations to diversify towards market-based activities do not guarantee the enhancement of current coping capacities. Interventions must recognise and account for different hazards, varying levels of homogeneity in community activities, and the institutional barriers and opportunities of different communities.

2 Coping with climate induced hazards in rural households in Uganda

How rural households in natural resource dependent communities respond to and cope with livelihood shocks has been examined through the use of the Sustainable Livelihoods Framework (SLF)(Chambers 1987; Scoones 1998). The SLF is now commonly used to help understand how rural livelihoods are diversified as part of a strategy to cope with shocks (Ellis 1998). For example, livelihood diversification includes diversification of income sources from farm to non-farm income (Paavola 2008), agricultural diversification including the use of better suited crop varieties (Deressa *et al.* 2009) and migration, often to provide remittances (Konseiga 2006). Whilst livelihood diversifications are considered planned changes made in response to stress, coping strategies are widely understood as impromptu responses to sudden shocks (Ellis 1998). Therefore short-term adjustments to a households' livelihood portfolio or drawing on available capital assets to minimise the effects of sudden shocks are common place. For example, drawing on savings, consuming food stocks, and selling livestock amongst other strategies are undertaken depending on the context of both the shock and household (Oyekale and Gedion 2012; Thornton *et al.* 2007; Chuku and Okoye 2009). Investigations into coping and adaptation are often differentiated between risk management approaches focuses on hazard-coping strategies and adaptation considering the impacts of climate change (Agrawal 2008). For example, selling assets may be a strategy adopted by a household to cope with a drought, whereas they may adopt more drought tolerant crops as means to adapt to an increasing drought trend (Birkmann 2011). Therefore whilst the focus of this review is on coping,

discussions on household coping strategies to floods and droughts are often relevant to discussions on household adaptation, and vice-versa.

Across the climate change literature, household coping strategies have been considered from both hazard vulnerability and political economy perspectives. Early studies considered hazard impact to be determined by the biophysical characteristics of an event (Liverman 1990; Lewis 1999). For example the differentiation between the resulting impact stems from how rapid-onset events such as floods may occur with limited warning and require an immediate response in order to reduce their impact (Blaikie *et al.* 1994) whilst slower-onset drought events often have long lead-up times, providing opportunity to prepare for the event. However, recent studies have focused on the 'root causes' of hazard vulnerability and how the severity of the impact results in part from human developments (Pelling 2003). Therefore whilst two households may have the same asset base and livelihoods, in different locations they will be embedded within different social, political and economic systems: it may be individual circumstances that will determine whether a household can take advantage of the opportunity to prepare for a drought, rather than the characteristics of the drought itself. Typically floods are relatively short term hazards compared to droughts which may last many months. However, floods in sub-Saharan Africa have been known to last several months, such as the floods in Mozambique in 2000 (Hellmuth *et al.* 2007). Significant attention is now given to understanding how the wider process, power relations and values of society shape both the hazard vulnerability and the success of the associated household coping strategies (Adger 2003; Brooks *et al.* 2005; Adger *et al.* 2009).

Where the wider adaptation literature has sought to better understand coping and adaptation responses, there is now a broadly recognised set of factors that are known to potentially influence the adoption of a particular coping strategy. For example, behavioural factors such as risk perception, as well as socio-economic characteristics such as education, wealth, age and gender are all argued to shape choice of coping strategy (Grothmann and Patt 2005; Deressa *et al.* 2009; Below *et al.* 2012; Hisali *et al.* 2011). Whilst these factors are widely acknowledged, and the range of coping strategies used by farmers in Africa widely known (see for example Below *et al.* 2010), there is still a need to focus on and understand how these factors drive the adoption of particular strategies depending on the particular hazard experienced. The literature that has focused on coping with different hazards has made little separation between specific hazard events. For instance Osbahr *et al.* (2008) found in Mozambique that diversification and collective land-use management were both used in response to climatic disturbances. However these responses were analysed in combination with responses to food security and poverty, without differentiating between shock-specific strategies. Kristjanson *et al.* (2012) further explored the relationship between food security and

adaptation and whilst food insecure households were found to undertake fewer adaptive actions, the relationship is too complex to recommend a single solution. Other studies in Uganda have shown that selling livestock is widely used to deal with covariate natural disasters, but this did not account for individual climatic shocks(Helgeson *et al.* 2013). Therefore explicitly identifying how factors such as wealth, age and choice of livelihood affect coping strategies of particular hazards contributes towards further understanding of drivers of climate adaptation activities, especially considering the ways different farmers may perceive climatic variations (Osbahr *et al.* 2011).

Strategies to cope with multiple stressors are important. Adaptation (and coping) strategies do not automatically reduce household poverty, just like poverty reduction activities do not automatically improve capacity to respond to climatic stresses (Eriksen and O'Brien 2007). There are complex dynamics that exist in determining levels of poverty (see for example Okwi *et al.* 2007; Krishna *et al.* 2006). The literature provides valuable arguments concerning the need to consider both the direct impact of other stressors, and how coping with one stress can indirectly shape responses to others. This 'double exposure' as it is termed has been examined to better understand how climate, environmental, economic and political shocks can compound each other (Silva *et al.* 2010; O'Brien and Leichenko 2000). Furthermore, similar tensions can be found within the temporal difference between hazards. For example, as Tarhule (2005) found, households prone to drought may relocate closer to water sources to cope with reduced water availability, yet in doing so increase their exposure and vulnerability to unexpected short term shocks such as flooding. Comparably, coping strategies to short term shocks will differ from those used for long term trends, or between rapid onset and slow-onset events. Research into coping with multiple stresses has challenged perceptions about those most vulnerable to environmental stress, showing the need to consider those directly *and* indirectly affected (Hjerpe and Glaas 2011; Quinn *et al.* 2011). If analysing multiple stressors reveals new 'winners and losers' (O'Brien and Leichenko 2000), then likewise analysing multiple *climatic* hazards can help to substantially contribute towards current climate adaptation debates.

This review has shown how context specific drivers and more generalised factors are important in understanding choice of coping strategy. Whilst the differing characteristics of floods and droughts may dictate particular responses, there still remains limited research into understanding other factors that differentiate choice of coping strategy of different hazards. The following analysis focuses on the socio-economic factors identified in this review as important for coping, such as livelihood activity and wealth, and how these factors shape the response to different hazards. By doing so, we shed light on what may determine a household to undertaken a particular coping strategy in one hazard, and why this may, or in some cases may not, differ during different hazards.

3 Methods

This study focuses on two communities in Uganda, specifically in Kasese district where both floods and droughts occur, and where the population is highly vulnerable to future climatic changes (Oxfam 2008). A short-list of study villages were identified through discussions with key-informants to identify locations that had experience of both floods and droughts. Two villages, Kigando and Kahendero[1], were then selected to provide evidence from locations with different customary and market-based opportunities in order to explore the range of strategies used by different households (Figure 1), whilst being largely representative of villages in the wider Kasese district. Between January and June 2012 we surveyed 108 households in Kigando (96%) and 190 in Kahendero (76%) to capture information on household demographics, assets, and livelihood activities, the perceived impact of floods and droughts on activities, and market access. A selection of households were then purposefully sampled to obtain a cross-section of households based on age, gender, education level, wealth, and livelihood activity (n=17 in Kigando and n=19 in Kahendero). Interviews and surveys enabled triangulation of the data, supported by observation and informal conversations. Questions about livelihoods were asked first, enabling a progressive enquiry towards floods and droughts, and later towards longer term climatic changes without biasing respondents.

Semi-structured interviews were coded for household coping strategies during flood and drought events. These strategies were then analysed through both qualitative interpretation and statistical association. Analyses of survey data were undertaken using descriptive and analytical statistical methods. Most variables such as gender, age and education level of the household head were obtained directly from the survey with the exception of both livelihood strategies and wealth, which were computed as part of an interim analysis, set out in the following section.

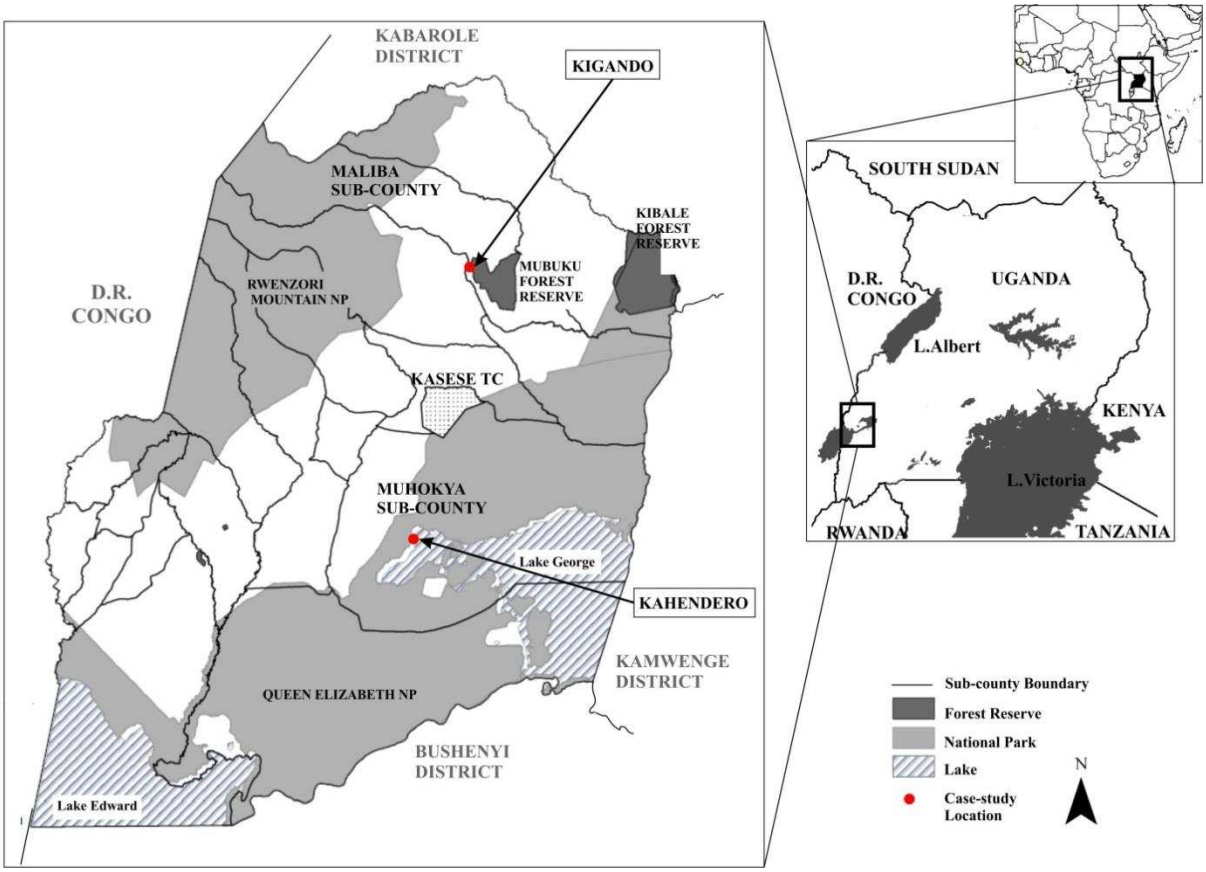

Figure 1. Location map of study sites, Kasese District, Uganda. Data provided by Kasese District Local Government (KDLG, 2012).

3.1 Characterisation of case studies and development of socio-economic indicators

The surrounding environs of both Kigando and Kahendero and the associated resource constraints shape the different activity profiles of the two communities. Fisheries based livelihoods are afforded to residents in Kahendero by the lakeshore location, whereas crop farming and livestock keeping are restricted due to the proximity of Queen Elizabeth National Park (QENP) and therefore the presence of wildlife corridors and the reduced availability of land. Livestock keeping is more prevalent in Kigando due to the neighbouring forest reserve providing land for livestock grazing. However Kigando's residents are restricted from substantial engagement in market-based activities due to the limited trading activity within the village. Distinct livelihood groups were identified within each village and the subsequent livelihood strategies are shown in Table 1. In Kigando, the dominant crop was beans, followed by maize then cotton. In Kahendero, cotton was most frequently grown, followed by ground-nut and then maize.

Table 1. Livelihood strategies (proportion of households)

Strategy	Activities*	Overall	Wet Season	Dry Season
Kigando				
Crop	Crop	28 (25%)	28 (25%)	36 (33%)
Diversified Crop	Crop, NR or Livestock	69 (64%)	69 (64%)	62 (58%)
Service	Crop, NR or Livestock, Service	11 (11%)	11 (11%)	10 (9%)
Kahendero				
Fish	Fish	30 (16%)	44 (23%)	51 (27%)
Diversified Fish	Fish, Crop/NR	82 (43%)	68 (36%)	59 (31%)
Crop	Crop or NR (or both)	24 (13%)	34 (18%)	35 (18%)
Service	Service (and other)	51 (27%)	41 (21%)	40 (21%)
No activity	No activity	3 (2%)	3 (2%)	5 (3%)

*In both villages, 25% of households surveyed engage in only one activity. Out of this 25%, in Kigando, this was all crop farming and in Kahendero, fishing = 57%, service-based = 18%, trading food stuffs = 12% and crop farming = 6%.

Whilst the literature review identified wealth as a key factor to be investigated it was not possible to directly record income during the survey due to the variation in dependence on subsistence activity across both villages. Instead, estimated wealth levels were computed using asset indicators to create a relative wealth index (Filmer and Prtichett 2001; Córdova 2008). Following the method of Córdova (2008) we used Principal Component Analysis (PCA) to assign weights to household assets to generate a proxy for wealth, the '*wealth index*'. Assets with most variation across households are weighted greater than those more commonly found. Both villages were jointly analysed due to the data requirements of PCA (Tabachnick and Fidell 2013) and given both were reported to have similar poverty levels (KDLG 2012). Table 2 summarises the results of the PCA. Wealth groups were then computed for each village based on the wealth index score of each household: average wealth scores were greater in Kahendero than in Kigando (except the *moderately wealthy*) and the majority of households in both villages were '*very poor'* (Table 3).

Table 2. Results from Principal Component Analysis to determine Factor scores for wealth index

Asset	Mean	Std. Dev.	Factor Score
Radio	68%	0.465	-0.106
Motorcycle	7%	0.256	0.129
Bicycle	22%	0.416	0.084
Mosquito Net	67%	0.471	0.010
Generator	2%	0.141	0.478
Solar Panel	1%	0.115	0.433
Mobile Phone	62%	0.485	-0.099
Television	2%	0.141	0.359
Lantern	42%	0.494	0.073
Torch	58%	0.494	-0.138
Largest Eigenvalue, λ	2.080		
Proportion of Variance Explained	20.802		

Kaiser-Meyer-Olkin = 0.668

Table 3. Distribution of wealth groups

Classification	KIGANDO			KAHENDERO		
	Households (Number)	Households (Percent)	Ave. Wealth*	Households (Number)	Households (Percent)	Ave. Wealth*
Very Poor	39	36.1%	-0.3817	104	54.7%	-0.3990
Poor	27	25.0%	-0.1304	32	16.8%	-0.1377
Moderate	23	21.3%	0.1076	37	19.5%	0.0964
Relatively Wealthy	19	17.6%	1.0164	17	8.9%	2.2913

*Mean scores for First Principal Component

3.2 Socio-economic drivers of livelihood strategy

The use of a mixed-methods approach to this study requires a preliminary analysis of the quantitative survey data to provide a background to the main analysis. What follows is a brief analysis of how livelihood activities were characterised by different socio-economic household characteristics which then informs the interpretation of the main results into what drives choice of coping strategy.

In Kahendero, a statistically significant relationship between livelihood strategy and education, gender and wealth[2] is observed (Table 4). Service-related activities were undertaken by more educated households whilst less educated households undertook a mix of fishing, arable farming or other natural resource activities. Fishing was dominated by male-headed households, largely due to cultural tradition. Furthermore, where younger members of a household would have been introduced to fishing through paternal activity, this was limited in female headed households. *Relatively wealthy* households did not exclusively engage with fishing, with at least half of these households relying on service related activities. In fact, 70% of households who depended entirely on fishing were either '*very poor*' or '*poor*'. The lack of initial investment required to work as *barias* (crew) made fishing a popular activity amongst the poor. Yet income from fishing often exceeds that from crop farming. Therefore the characterisation of fishing based households' result from both higher income levels and the traditional male-dominance of fishing[3]. In contrast, the household profile in Kigando is more homogenous in terms of wealth, education level and livelihood activity, and therefore households are not easily differentiated by socio-economic variables or livelihood activity (. Relationship between livelihood activity and socio-economic household characteristics

	Kigando			Kahendero		
Characteristic	χ^2	***df***	***p***	χ^2	***df***	***p***
Age	12.116	6	0.059	18.481	12	0.102
Gender	1.572	2	0.456	20.274**$_a$	4	<0.000
Education level	4.186	4	0.381	27.392**$_b$	8	0.001
Wealth group	6.550	6	0.364	26.219**$_a$	12	0.010

* p<0.05, ** p<0.01

[a] 40% of cells have expected count less than 5, and test for independence is violated.

[b] 3 cells (20%) have expected count less than 5. Minimum expected count is 0.70

Table 5). Market-access, indicated by the frequency in which households visit a market (to buy or sell goods) is greater in Kahendero: 70% of respondents directly accessed a market at least twice a week, compared to just under 40% in Kigando. Therefore whilst households in both villages have at least some degree of market-access, this was more apparent in Kahendero.

Table 4. Relationship between livelihood activity and socio-economic household characteristics

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Table 5. Characteristics of case-study areas

Characteristic	**Kigando**	**Kahendero**
Population	~620	~930 (fluctuates seasonally)
Gender of household head	Male: 78% Female: 22%	Male: 84% Female: 16%
Average age of household head	47	40
Education	No formal education: 31% Primary: 56% Secondary: 13%	No formal education: 23% Primary: 51% Secondary: 26%
Market access	Bi-weekly market 3km away, no market in village. Less than 40% of households access market more than twice a week.	Formal market 3km away, trading stalls erected two/three times a week, and daily fish market at landing site. 70% of households access market at least twice a week.

The varying levels of customary and market-orientated livelihood activities across the two villages, combined with the difference in socio-economic household characteristics and the physical environs of each village interact to shape the context within which the following analysis of coping strategies is interpreted (Table 6).

Table 6. Household and village characteristics of customary and market-based livelihoods

	Customary-based rural livelihoods	Market-orientated rural livelihoods
Household	Older household heads Less educated households Poorer households	Younger household heads More educated Wealthier households
Village	Low diversity of activities Lower overall community wealth Isolated communities disconnected from markets	Wider diversity of activities Greater overall community wealth Communities connected with market opportunities
Example	***Kigando***	***Kahendero***

4 Results

4.1 Household coping strategies

Household coping strategies vary depending on the hazard experienced (Figure 2). The most common flood coping strategies were *agricultural practises* (23%), *economic activities* (22%) and *social support* (20%), whereas during a drought these were *economic activities* (27%), drawing on *savings* (16%) and *social support* (14%). *Agricultural practices* included management techniques such as soil conservation techniques during floods (i.e. digging trenches), and water conservation techniques during droughts, as well as climate sensitive practices such as delaying planting until the first rains, and multi-cropping. *Economic activities* included non-farm income generating activities such as market-trading, fishing and employment outside the village.

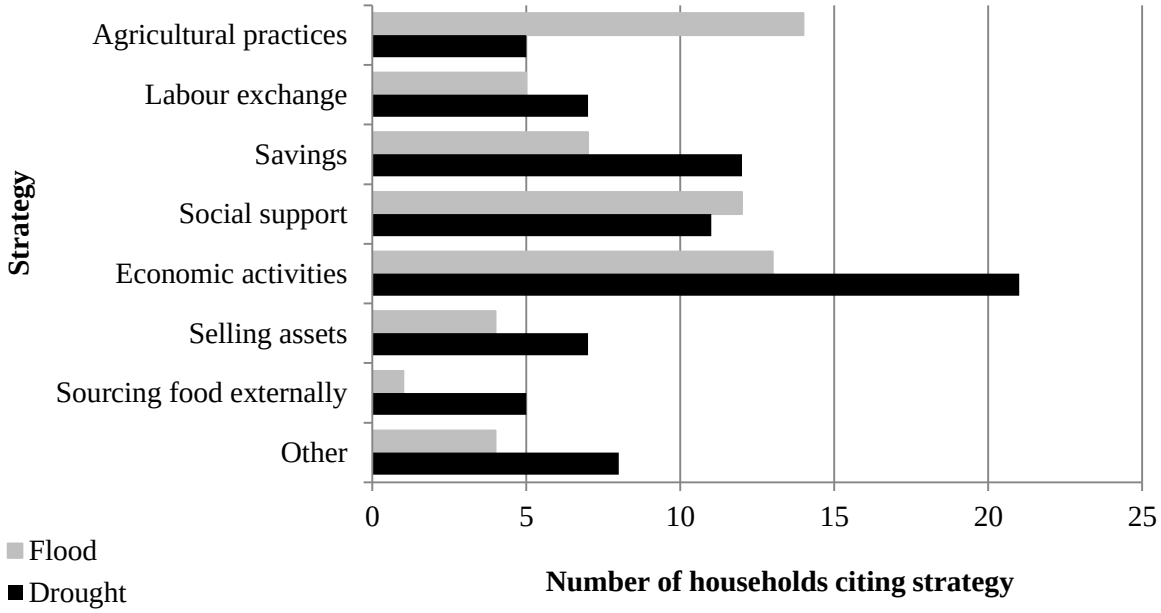


Figure 2. Flood and drought coping strategies identified during semi-structured interviews

The inherent characteristics of floods and droughts lead some coping strategies to be more suited to one hazard or another. *Agricultural practices* were most commonly used during floods rather than droughts, such as digging trenches to divert flood water. However, whilst respondents were aware of using techniques such as mulching and water conservation (techniques) during periods of low rainfall, these were only identified as ways to maximise crop yields rather than as specific drought coping strategies. Likewise, *savings* and *selling assets* were more important during droughts than floods. Conserving assets during the wet season enabled households to sell them off during a drought, whereas reduced farming activity in a typical dry season makes it harder to build up assets to prepare for flooding. However, there remain variances within the adoption of particular coping strategies as shown in Figure 2, which indicates how different hazards demand different strategies.

Yet Figure 2 does not indicate whether any specific household uses the same coping strategy regardless of hazard. *Savings* (in Kahendero) and *social support* (in Kigando) were the only two strategies that were found to be used by the same households in both hazards[4], confirming that most households undertake different coping strategies during different hazards. To understand what drives this choice of coping strategy it is necessary to investigate at both the household and village level.

4.2 Drivers of coping strategy

Socio-economic factors are important in choice of coping strategy, particularly those of age, education and wealth, as shown in Table 7. During floods, we observed older households were more

likely to rely on social support than younger households. Whilst other studies argue that older farmers are most likely to reduce consumption (Hisali *et al.* 2011), this is likely to lead households to rely on *social support* to access basic levels of food and resources.

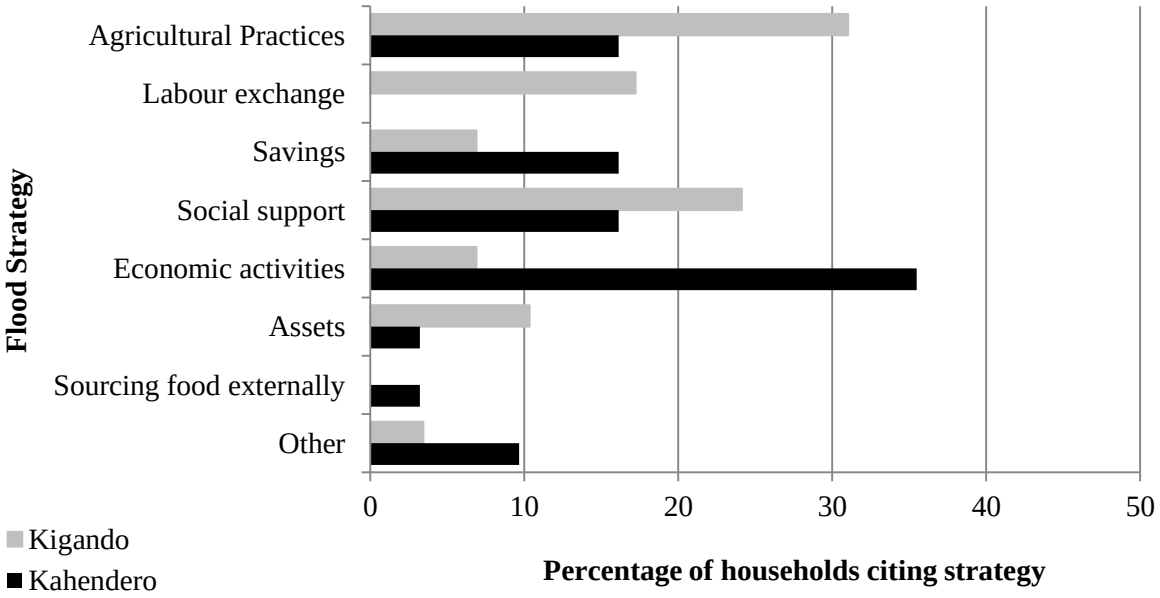
Table 7. Household drivers of coping strategy

	Flood	Drought
Age	**Older** household heads favoured *agricultural practices*, then *economic activities* and *social support*. **Younger** household heads favoured *economic activities* and *savings*.	No differentiation with age.
Education	No differentiation with education.	**More educated** households drew on *savings* before *economic activities*. **Less educated** relied on *economic activities*.
Wealth	**Very poor** relied on *agricultural practises*. **Poor** relied on *social support*. **Wealthier** households relied on *economic activities*.	**Very poor** relied on *economic activities*. **Poor** relied on *social support* and *labour exchange*. **Wealthier** households relied on *economic activities.*

Education was also found to drive choice of coping strategy. More educated households relied most on savings, likely to result from these households being known to more easily secure savings (Kiiza and Pederson 2001) due to greater livelihood diversity. However less educated households whom undertook diverse livelihood strategies preferred relying on *social support* regardless of hazard. This could reflect the market activity of the communities: households from Kigando (where there was a lower level of education) who depend most on customary activities and the lower income returns associated with those activities, rely more on *social support* than *savings*.

Household livelihood strategy therefore has implications for coping strategy. Households engaged in customary farm-based livelihoods undertook *agricultural techniques* to cope with floods and *sourcing food externally* or *social support* during droughts. As livelihood diversity increased, so coping strategy differed: where customary livelihoods were supplemented with livestock keeping, petty trading or service-based activities, households undertook *social support* and *economic activities* as flood coping strategies and *labour exchange* and *social support* during droughts. However, those households with market-orientated livelihoods relied on the same (*economic*) activities regardless of hazard. The ability to engage in market-based activities determined whether households could draw on financial capital during times of stress, and particularly whether they had to substitute financial capital based coping strategies with more human or social capital based ones.

Alongside the preliminary analysis which showed the two villages differed in terms of market-opportunities and land access, coping strategy is seen to vary by location (Figure 3). Whilst differences between responses may have been symptomatic of the risk variance of each hazard, some strategies were more common in one village than the other.



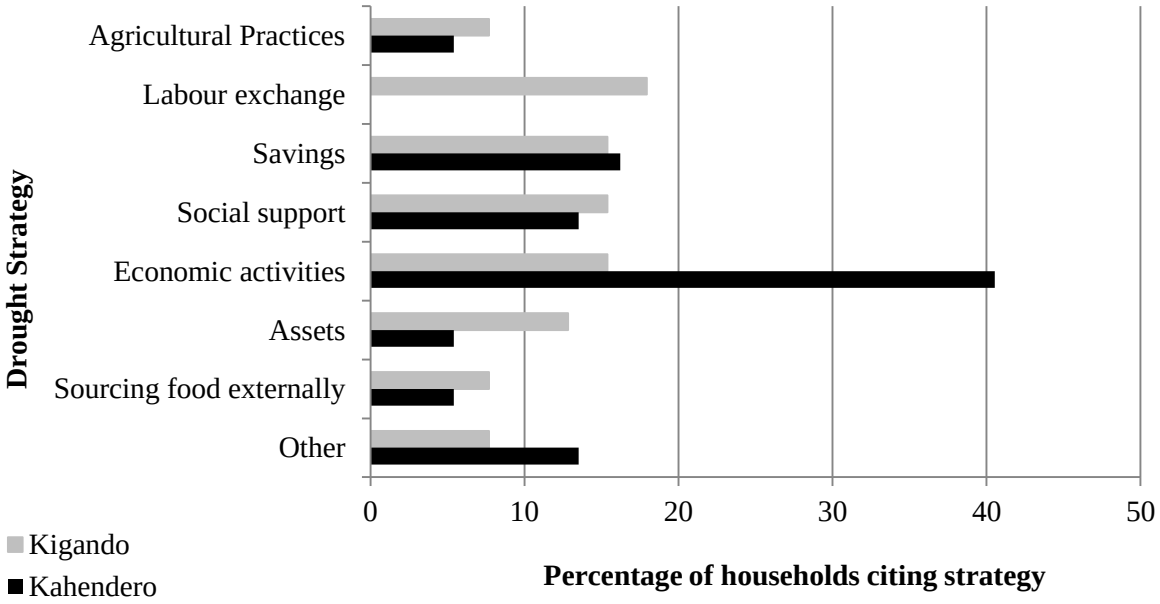


Figure 3. Flood (3a) and drought (3b) coping strategies, as undertaken within each village.

Village determinants of coping strategy

Selling assets, such as durables and livestock was most common in Kigando. In Kahendero, the risk of heavy fines and imprisonment if their livestock was found within QENP meant only 13% of households kept livestock. However the surrounding environs enabled 61% of households in

Kigando to keep livestock and therefore draw on this resource as a coping strategy. These households openly discussed using the adjacent Mubuku Forest Reserve for grazing, despite its protected status. The surrounding physical environs and the customary and formal land tenure arrangements have determined how successful the use of *selling assets* is as a coping strategy. Access rights to land surrounding Kigando enabled households to keep livestock which can be sold in times of stress, whereas in Kahendero restricted access rights limited livestock selling options. However, new co-management regulations and policies that will impact on the Mubuku Central Forest Reserve adjacent to Kigando risk impacting on future livelihood and coping options:

> *I sometimes graze my cattle in the forest, which is from the Government and sometimes...if they find me here, they would fine me. But this is the only land that can accommodate my cattle.*
>
> (Kigando livestock keeper, 2012)

Beyond the impact of the surrounding environs, which village the households was located in was found to further influence coping strategy: both *labour exchange* and *economic activities* were found to significantly vary by village (Table 8). Only households in Kigando cited *labour exchange* as a strategy (mostly off-farm agricultural practises). Despite households in Kahendero engaging in non-farm labour exchange such as fishing for others, this was only recognised as part of a wider livelihood strategy, rather than a specific coping option. These households in Kahendero however were significantly more likely to engage in *economic activities*, largely as a result of the developing service activity around the lake-shore landing site which provides greater opportunities for households to access markets than in Kigando.

Table 8. Chi-square tests for independence between coping strategies and village

	Flood		**Drought**	
	Labour Exchange	Economic Activities	Labour Exchange	Economic Activities
χ^2	4.236*[1]	6.397*	7.261**[2]	7.023**
p	0.039	0.011	0.007	0.008
phi	-0.425	0.479	-0.519	0.498

[1] 2 cells (50%) have expected count less than 5. Minimum expected count is 2.36
[2] 2 cells (50%) have expected count less than 5. Minimum expected count is 3.31
* $p<0.05$, ** $p<0.01$

Further evidence for village differentiation is supported by the previous findings whereby *savings* in Kahendero and *social support* in Kigando where the only two strategies identified to be undertaken by the same households during both floods and droughts. Not recognising *labour exchange* as a specific coping strategy, households in Kahendero instead relied on business activities when fishing or farming failed, or during other financial challenges both as an immediate response, and to bolster

their savings activities. In Kigando, social support networks provided access to off-farm and non-farm labour exchange opportunities as additional coping strategies. Supplementing these support networks were savings groups, but unlike in Kahendero these were relied upon more during challenges indirectly linked to climatic hazards than as specific flood or drought coping strategies:

> *I realise I can go and get a loan to help me buy these seeds then after I've planted and harvested I can then try and return this money*.
>
> (Kigando farmer, 2012)

In Kigando, the majority of savings resulted from the sale of crop yields, thus climatic events could indirectly affect households across the village:

> *My home is not affected by floods, but is affected by hunger and famine. It is not affected by floods, but it is affected by savings*.
>
> (Kigando savings group member, 2012)

Income sources in Kahendero were less sensitive to climatic hazards, enabling some residents to regularly deposit with these savings groups. This steady income for the savings group afforded households that were affected by floods or droughts better access to loans compared to those in Kigando.

5 Discussion: Livelihood activity and coping responses

Investigating both socio-economic household drivers of coping strategy, as well as factors at the village level highlights how livelihood activities and the associated coping strategies vary depending on the levels of customary activities and market-based opportunities within the village. Natural resource availability, migratory activity and economic structures provide opportunities to diversify livelihoods. Yet household factors can further shape both livelihood and coping strategies by enabling or constraining households to take advantage of supposed opportunities. Yet it is the interactions between these factors that determine household coping responses. We categorise these interactions along the axes of types of household livelihood and village activity, and identify four contextual drivers of coping. These are environmental, resource, income and diversification (Figure 4).

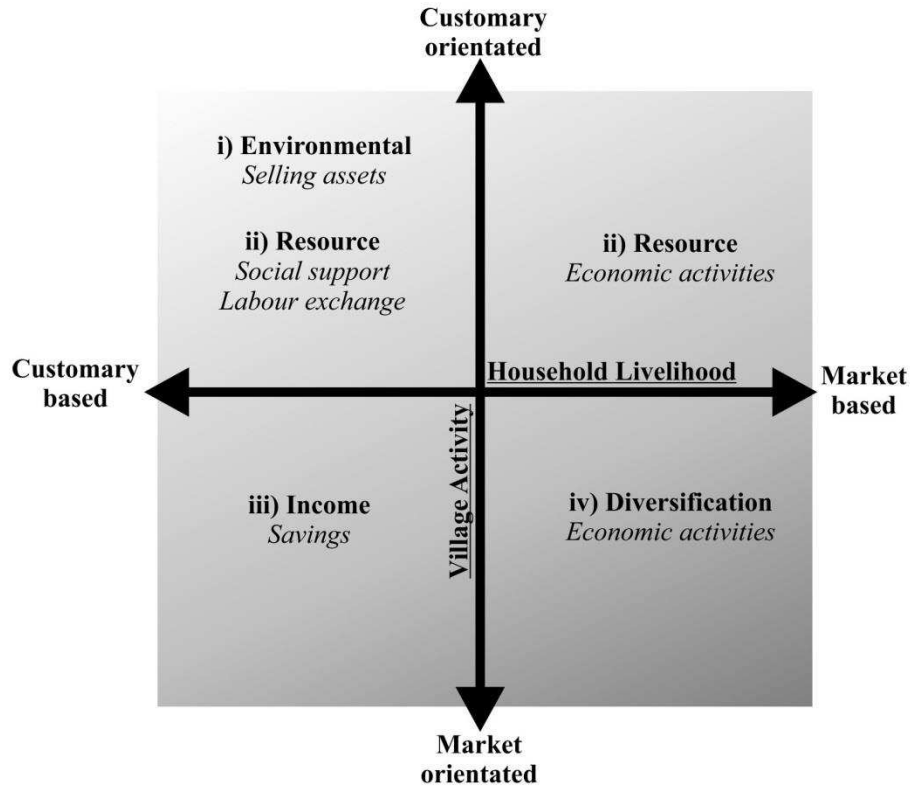


Figure 4. Coping strategy framework showing the interaction between village activity (vertical axis), household activity (horizontal axis) and the resulting drivers of household coping strategy: environmental, resource, income and diversification.

i. Environmental drivers

Whilst physical characteristics of a hazard event play a role in determining the impact a hazard has (Lewis 1999; Liverman 1990), the physical characteristics of the context a household is placed within will affect their choice and ability to undertake a particular coping strategy. The access rights to the surrounding environs can disadvantage some communities (Hisali et al. 2011), such as Kahendero, whilst these rights are increasingly important to others. Livestock is an important form of security (Mogues 2006), especially within the more customary-orientated locations, such as Kigando. However, changing land tenure arrangements will impact future adaptation options, whereby policies and actions designed to conserve land can undermine the coping strategies that some households utilise during times of climatic stress. Relying on coping strategies which can be so readily affected by external processes can lead to increased vulnerability of these households.

ii. Resources drivers

Across the two villages, wealthier households would engage in *economic activities* during both hazards whilst poorer households were found to adapt their strategies depending on the shock.

However, non-farm income generating activities may not be reliable during droughts as the overall income and therefore spending within a community dependent on natural resources may decrease (Eriksen *et al.* 2005). Nonetheless, some studies observed such activities increase during drought (Cunguara *et al.* 2011) especially in market-orientated communities where there is more continuous trading activity. Thus economic activities may prove a more resilient coping option where there is strong market-access but may leave households in more customary-orientated communities vulnerable to repeated drought events.

However, households in more market-orientated contexts may also be constrained in their choice of strategy. *Economic activities* and *savings* strategies may prove necessary in order to overcome reduced levels of social capital (Bryan *et al.* 2009). For example, Kahendero is both larger than Kigando, experiences high level of in-migration due to the attraction of market opportunities, and has seasonal population fluctuations due to the fishing activity. These factors negatively impact on social cohesion, limiting household coping abilities to environmental impacts (Pretty 2003). Therefore residents in communities such as Kahendero actively seek alternate coping options. Hence, coping strategies in more customary based locations with greater social cohesion may be more dominated by *social support* based activities. The dependence on *labour exchange* as a strategy in Kigando reflects the opportunities afforded to households through social networks, which are known to be important in diminishing risk (Osbahr *et al.* 2008; Adger 2003). Likewise, *labour exchange* was not cited by households in Kahendero, where there was also less utilisation of social support strategies. Therefore social support systems have both a direct and in-direct role to play in enabling the adoption of particular coping strategies.

Yet can social support provide coping options regardless of hazard? Whilst the covariate nature of droughts can disrupt the social support network more than floods, the different impacts that different hazards present to households also dictates choice of strategy. For example, sudden disruptions from floods may require reliance on social support, whilst slower-onset events such as droughts enable households to prepare themselves.

iii. Income drivers

Wider diversity in community activities results in the increased viability of income generating activities during hazards, especially droughts. For example in Kahendero, the savings portfolio is more resilient to shocks and is therefore used more as a coping strategy than by households in less diverse communities. Continual income sources afford regular savings to be made which increases the availability of drawing on savings as a coping strategy (Roncoli *et al.* 2001). Thus maintaining regular inputs into savings groups enables those that need loans to do so.

Meanwhile, less diverse communities who largely engage in natural-resource activities are likely to experience fluctuations in income in line with climatic shocks. In turn, this results in savings groups being unable to supply loans. Households therefore rely less on *savings* as a direct coping strategy for climatic hazards, similarly reported elsewhere as reductions in borrowing and begging strategies (Helgeson *et al.* 2013). Therefore providing there is diversity in community livelihoods, service-based activities buffer households in natural resource dependent communities from drought induced income reductions.

iv. Diversification drivers

Livelihood diversification and coping strategies are recognised as separate activities (Ellis 1998), yet diversification can improve coping opportunities (McLeman and Smit 2006). Whilst households with diverse long-term livelihood strategies are known to be better positioned to offset climate risk than those who rely on non-farm work as short-term coping strategies (Cunguara *et al.* 2011), this success depends on existing customary livelihoods. Limited market opportunities restrict households in Kigando from alternate livelihood strategies, let alone coping strategies. Yet even where diversification is possible, it may not always reduce risk (Silva *et al.* 2010). For example, income diversification risks eroding social cohesion that has built up around particular activities, thereby reducing alternate coping strategies. Or for instance in Kahendero, diversifying into fishing may increase income yet it carries greater risk through fluctuating fish stocks and renewing expensive equipment if broken. Whilst declines in fish stocks were acknowledged by respondents, the associated risk of reduced market opportunities was not. Both reduced market activity from a decreasing fishing market, and that continual increases in new businesses could over-saturate the local market were both under recognised.

Diversification arguments are also not devoid of gender considerations. Socio-economic factors clearly drive choice of coping activity. Indeed our findings resonate for example, with those of Eriksen *et al.* (2005) that gender is important in household decisions to specialise in an activity. However, we find it is not so much choice but restrictions that lead to specialisation such as the traditional absence of women's participation in fishing. Thus, the lower income-return activities that female headed households are restricted to also subsequently limit their available coping strategies through both livelihood dependent strategies and additional strategies, such as *savings*. Consequently it is not only household or community culture that is important (Nielsen and Reenberg 2010; Motsholapheko *et al.* 2011), but also the culture of the activity itself.

Diversification away from traditional customary activity also leads to shifts towards more market-based coping strategies. Diversifying away from farm-based opportunities may support drought coping capacities (see also Antwi-Agyei *et al.* 2012; Paavola 2008) but may lead to tensions

between coping with different hazards (Tarhule 2005). For example, flood strategies may be restricted by reducing off-farm *labour exchange* opportunities as a result of reduced on farm activity. Diversification may therefore erode current coping capacities without providing sustainable alternatives. Whilst some households' can, and do, transition from traditional resource dependent livelihoods to more market-based activities, it may remain difficult for a whole community to follow. In Kahendero, fishing, and to a lesser extent crop farming enables market trading to exist, thus if households transition away from these activities, the local market may collapse.

Implications for coping and adaptation policy

By investigating household and village drivers of household coping strategy, our findings highlight the importance of considering how the interactions of these drivers shape the available coping strategy of a household. More specifically, environmental, resource, income and diversification drivers shape different support mechanisms due to the different coping strategies they enable. The literature calls for adaptation policies that target the marginal in society, such as women, children, elderly, or the poor (Cunguara *et al.* 2011; Tanner and Mitchell 2008), arguing that these groups will remain most vulnerable. Yet these groups do not respond to climatic hazards homogeneously: the poor, or the elderly, or the less educated adapt their coping strategy depending on the hazard experienced. Adaptive strategies also depend on the heterogeneity of the community as well as wider factors including access and provision of markets and security of credit schemes. Policy must support households to diversify income activities to continue to cope in times of drought, whilst ensuring that they support and foster social capital which is increasingly relied on during floods. For instance, the poorest households vary strategy by hazard and need support to participate in savings groups, especially where market-based opportunities are limited. Enhancing a supportive social foundation provides the groundwork from which members of such groups can collectively diversify their activities, especially where social capital is more readily available than financial capital. Indeed participation in such groups is an important mechanism through which households receive formal support, for example, through the National Agricultural Advisory Service, NAADS (see further discussion in Bahiigwa *et al.* 2005; Osbahr *et al.* 2011).

Market access is widely identified as important in determining levels of diversification (see for example Motsholapheko *et al.* 2011; Cunguara *et al.* 2011; Paavola 2008) yet caveats remain. The level of customary activities and market opportunities must be considered for livelihood diversification policies to be successful. For example, cultural activities and land tenure and access limit livelihood activities which restrict available coping options. The coping strategies that remain inevitably shape the availability of future adaptation options, through for example, reducing the asset portfolio of a household. Both physical and institutional limits and constraints surrounding

access to non-farm activities make diversification unsuitable for all rural communities. Further research is necessary to understand the contexts in which these limits and constraints exist.

6 Conclusion

In this study, we have shown how household livelihood strategies of two communities in Uganda are ultimately shaped by socio-economic household characteristics as well as the surrounding cultural, economic and environmental contexts. By using a framework that analyses coping strategies along interacting axes of household and village activities, we have discussed how the contexts that determine household coping strategy arise from different levels of customary activities and market access. It is important to consider socio-economic household characteristics in order to provide a targeted approach to specific groups, and further research is needed to specifically address the types of strategies each group may require. Such research may further develop the proposed framework. By examining the two different community contexts of Kigando and Kahendero we have shown how these factors shape the available coping strategies of different households: *labour exchange* and *social support* were common coping strategies within Kigando, whilst *economic activities* and *savings* were preferred in Kahendero. Analysing these drivers from the perspective of two different climatic hazards, floods and droughts, we have also shown that household coping mechanisms differ under different manifestations of climatic variability.

Whilst our findings are context-specific, they reveal characteristics of communities that should be considered in wider coping and adaptation debates. For example, the level of customary-based activities and opportunities for market-orientated activities must be considered within coping and adaptation, especially in order to consider the barriers and constraints concerning diversification activities. Unforeseen trade-offs between different (formal and informal) structures will determine the success of different coping strategies. How current coping strategies affect future adaptation options will depend on the interaction between socio-economic household characteristics and the wider village context, and will manifest differently depending on the hazard experienced.

Notes:

[1] Kahendero is formed from two villages '*Kahendero I*' and the larger '*Kahendero II*'. For the purpose of this research, *Kahendero I* was selected as a case-study and is referred to throughout as Kahendero.

[2] Minimum expected cell counts were violated for these tests. At least 80% of cells should have expected frequencies of 5 or more. Yet, observations made during data collection provide evidence to support these relationships.

[3] Chi-square test for association between wealth and gender in Kahendero $\chi^2(3, n=190) = 13.501$, $p<.01$.

[4] Chi-squared result were for *savings* in Kahendero χ^2 (1, n=19) = 10.72 p<.01 and *social support* in Kigando χ^2 (1, n=17) = 4.38 p<.05).

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