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Aspirations, shocks, and rural poverty

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Kurzfassung

Armut ist in vielen Teilen der Welt weiterhin ein großes Problem, insbesondere in Sub-Sahara Afrika (SSA). In dieser Region ist die Armut in den ländlichen Gebieten besonders stark ausgeprägt. Das hohe Armutsniveau wird durch die COVID-19-Pandemie weiter verschärft. Diese droht die jahrelangen Entwicklungsbemühungen und Fortschritte zunichte zu machen. Die vorhandenen Armutsfallen in Afrika wurden bisher auf wichtige externe Faktoren wie den Klimawandel, Konflikte, fehlende Infrastruktur, Ungleichheit zwischen den Geschlechtern und tief verwurzelte Strukturen wie die übermäßige Abhängigkeit von natürlichen Ressourcen zurückgeführt. Neben genannten externen Faktoren können aber auch interne Faktoren zur Armut beitragen. Individuelle ‚Aspirations' können verhaltensbedingte Armutsfallen durchbrechen oder aufrechterhalten. ‚Aspirations' sind Ziele, für deren Verwirklichung Personen Zeit, Geld und Mühe investieren. Sie sind zukunftsorientiert und unabhängig vom gegenwärtigen Erreichungsgrad.

In dieser Arbeit werden die Formung und die Auswirkungen von ‚Aspirations' anhand einer Umfrage unter 530 kenianischen Kleinbauern untersucht. Hierbei werden ‚Aspirations' in Bezug auf das Einkommen, das Vermögen, den sozialen Status, die Bildung und den Viehbestand sowie ein Erwartungsindex berücksichtigt. Außerdem werden die durch COVID-19 verursachte Ernährungsunsicherheit und die verschiedenen Strategien von Haushalten analysiert um mit Unterbrechungen des Nahrungsmittelzugangs zurechtzukommen. Hierfür kombinieren wir die Daten einer Umfrage in Kenia, Namibia und Tansania mit denen einer telefonischen Folgebefragung. Zur Beantwortung der Forschungsfragen werden vor allem ökonometrische, regressionsbasierte Methoden eingesetzt, die durch verschiedene Tests und aktuelle methodische Ansätze ergänzt werden, um relevante Mechanismen des Datengenerierungsprozesses zu identifizieren.

Die Arbeit gliedert sich in die Einleitung und fünf Hauptkapitel. Das zweite Kapitel befasst sich mit der Formung von ‚Aspirations', wobei die Rolle von begleitenden Faktoren, speziell ökologischen Schocks, untersucht wird. Im dritten Kapitel wird die Rolle kollektiven Handelns durch die Mitgliedschaft in einer Genossenschaft und die Auswirkungen von Vorbildern auf ‘Aspirations' zu Einkommen und Vermögenuntersucht. Kapitel vier beleuchtet inwiefern die Mitgliedschaft in religiösen Einrichtungen und die Religiösität mit den ‚Aspirations' der Eltern für die Bildung ihrer Kinder zusammenhängt. In Kapitel fünf wird die Beziehung zwischen ‚Aspiration Gaps' (Unterschied vom aktuellen Zustand zu den

‚Aspirations') und Investitionen betrachtet, wobei der Fokus auf der Viehzucht liegt. Das sechste Kapitel legt das Ausmaß der Ernährungsunsicherheit dar, verdeutlicht die Unterbrechungen der landwirtschaftlichen Tätigkeiten und des Zugangs zu Nahrungsmitteln im Zusammenhang mit COVID-19 und analysiert die entsprechenden Bewältigungsstrategien der Haushalte in Kenia, Namibia und Tansania.

Wir stellen fest, dass ‚Aspirations' negativ mit ökologischen Schocks korreliert sind. Insbesondere zeigt sich, dass die Ausbreitung des invasiven Baumes *Prosopis juliflora* wirtschaftliche Notlagen hervorruft und die ‚Aspirations' der Haushalte verringert. Wir stellen außerdem fest, dass ‚Aspirations' zu Einkommen und Vermögen mit der Mitgliedschaft in Genossenschaften zusammenhängen. Dieser Zusammenhang ist wahrscheinlich durch Vorbilder innerhalb der Genossenschaften hervorvorgerufen. Auch die Mitgliedschaft in religiösen Institutionen und die Religiosität stehen in einem positiven Zusammenhang mit den ‚Aspirations' der Eltern für die Bildung ihrer Kinder. Diese drei Kapitel stützen die Annahme, dass ‚Aspirations' sozial bedingt sind, aber auch durch Faktoren wie Schocks und materielle Ausstattungen beeinflusst werden. Außerdem finden wir eine invers-U-förmige Beziehung zwischen ‚Aspiration Gaps'und Viehbestand in Kenia. Investitionen in die Viehhaltung und Ersparnisse steigen mit den ‚Aspiration Gaps'bis zu einem bestimmten Schwellenwert. Ab diesem Schwellenwert nehmen sie dann ab bis hin zu einer ‚Aspiration Failure'. Im Rahmen der COVID-19-Studie berichten die Haushalte der drei Länder ein hohes Maß an Ernährungsunsicherheit und Ausfällen beim Zugang zu Nahrungsmitteln. Sie reagieren auf Ausfälle des Nahrungsmittelzugangs mit verschiedenen Strategien, wie der Reduzierung ihrer Nahrungsaufnahme, der Diversifizierung der Nahrungsquellen hin zu einer weniger nahrhaften Ernährung, der Intensivierung der Nahrungssuche, der Inanspruchnahme von staatlicher und humanitärer Unterstützung sowie der Hilfe durch Familie und Gleichaltrige. Insgesamt bestätigt diese Arbeit die Bedeutung von ‚Aspirations' für zukunftsorientiertes und möglicherweise armutsminderndes Verhalten. Sie trägt zum Verständnis der Formung von ‚Aspirations' bei, warnt aber auch vor einer zu engen Fokussierung auf ‚Aspirations' angesichts der nicht monotonen Beziehung zwischen Aspirationen und zukunftsorientiertem Verhalten.

Schlüsselwörter: ‚Aspiration formation', ökologische Schocks, kollektives Handeln, Vorbilder, Religiosität, ‚Aspiration failure', Viehbestand, COVID-19, Ernährungssicherheit

Abstract

Poverty remains a persistent problem in many parts of the world, especially in sub-Saharan Africa (SSA). In this region, poverty is particularly prevalent in rural areas. Further exacerbating the high levels of poverty is the COVID-19 crisis, threatening to reverse years of development efforts and progress. The existence of poverty traps in Africa has so far been attributed to major external constraints such as climate change, conflict, lack of infrastructure, gender inequality, and deep-seated structures such as over-reliance on natural resources. While acknowledging the above external constraints, internal constraints may also contribute to poverty. Individual aspirations may break or sustain behavioural poverty traps. Aspirations are defined as goals that individuals invest time, money, and effort to achieve. They are future-oriented and exclude present-level gratification.

This thesis delves into understanding the formation and impact of aspirations using a survey of 530 smallholder farm households in Kenya. Aspirations regarding income, assets, social status, education and livestock as well as an aspiration index are considered. In addition, the thesis examines COVID-19-induced food insecurity and the various coping strategies households are using to get on with disruption of food access. Here, a follow-up phone survey is combined with a joint baseline survey in Kenya, Namibia and Tanzania. Most prominently, econometric, regression-type techniques are employed to address the specific research questions complemented by different tests and state-of-the-art methodological frameworks to identify relevant data-generating mechanisms.

The thesis is divided into an introduction and five main chapters. Chapter two examines the formation of aspirations, looking at the role of circumstantial factors, specifically ecological shocks. Chapter three explores the role of collective action through cooperative membership, and the effect of role models on income and asset aspirations. Chapter four considers membership in religious institutions and religiosity and how this relates to the educational aspirations of parents for their children. In chapter five, the relationship between aspiration gaps (distance between current state and aspirations) and investments is considered focusing on livestock. Finally, chapter six documents the level of food insecurity, highlights disruptions in agricultural activities and food access related to COVID-19 and examines related coping strategies of households in Kenya, Namibia and Tanzania.

We find aspirations to be negatively correlated with ecological shocks. Specifically, the spread of the invasive, *Prosopis juliflora* is shown to induce economic adversity, reducing the aspirations of households. We also find income and asset aspirations to be associated with membership in cooperative groups. This association is likely driven by role models. Still in the line of social networks, membership in religious institutions and religiosity also exhibit a positive relationship with the educational aspirations of parents for their children. These three chapters strengthen the notion that aspirations are socially constructed but also driven by circumstantial factors such as shocks and material endowments. We then confirm an inverse U-shaped relationship between aspiration gaps and livestock in Kenya. Livestock investments and savings increase with aspiration gaps up to a threshold, from which they then decline, leading to an aspiration failure. For the COVID-19 study in the three countries, households report high levels of food insecurity and disruptions of food access. Households respond to food-access disruptions by employing coping strategies such as reducing food intake, diversifying food sources towards less nutritious foods, intensifying food search, receiving government and humanitarian support, and receiving help from family and peers. Put together, this thesis confirms the importance of aspirations for future-oriented and possibly poverty-reducing behaviour. It contributes to the understanding of how they are formed but also guards against a narrow focus on aspirations given the non-monotonic relationship between aspirations and future-oriented behaviour.

Keywords: Aspiration formation, Ecological shocks, Collective action, Role models, Religiosity, Aspiration failure, Livestock, Covid-19, Food security

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Abbreviations

AIPW	Augmented Inverse Probability Weighting
ASAL	Arid and Semi-Arid Land
ATE	Average Treatment effect
ATET	Average treatment effect on the treated
CABI	Centre for Agriculture and Bioscience International
COVID-19	Corona Virus Disease
FAO	Food and Agriculture Organization
FAW	Fall Armyworm
IHS	Inverse Hyperbolic Sine
IMF	International Monetary Fund
KNBS	Kenya National Bureau of Statistics
IV	Instrumental Variable
IPW	Inverse Probability Weighting
IPWRA	Inverse Probability Weighting Regression Adjustment
LPM	Linear Probability Model
MVP	Multivariate Probit Model
MTE	Multivalued Treatment Effect
PCA	Principal Component Analysis
OLS	Ordinary Least Square
PO	Potential Outcome
PSM	Propensity Score Matching
RI	Religious Institution
SSA	Sub-Saharan Africa
TLU	Tropical Livestock Unit
USAID	United States Agency for International Development

Chapter 1

Overview of the thesis

1.1 Background of the study

Poverty remains a persistent problem in many parts of the world, especially in sub-Saharan Africa (SSA). In this region, poverty is particularly high in rural areas, where the challenge of development also appears daunting (Mwabu and Thorbecke, 2004). The vast majority of people (82%) in SSA live in these rural areas, where they are mainly employed in agriculture, which remains their primary source of livelihood (Dercon and Gollin 2014; Beegle and Christiaensen, 2019). To promote economic growth and development in rural areas and achieve shared prosperity, many development policies have emphasized agriculture as a necessary pathway out of poverty, especially among the poorest of the poor (Christiaensen et al., 2011; Barrett et al., 2019). However, chronic poverty remains high, even though there have been some pro-poor growth spurts in the region[1] (Dang and Dabalen, 2019).

Further exacerbating the high levels of poverty is the COVID-19 crisis, which threatens to reverse years of development efforts and progress. It not only affects the broader macroeconomy but has implications for both monetary and non-monetary dimensions of poverty, such as human capital

[1] This growth was accompanied by a 9 per cent reduction in poverty and a growing middle class. About 60 per cent of the poor in Africa are chronically poor, while 40 per cent are in transient poverty.

development and food and nutrition security. It is estimated that 514 million Africans are at risk of falling below the poverty line (ECA, 2021). COVID-19-related lockdowns have led to market disruptions, business closures, and rising unemployment through job losses (Laborde et al., 2020). The impacts are greater on agriculture-dependent and informally employed households, most of which can be considered poor (Swinnen and McDermott, 2020; Bargain and Aminjonov, 2021). Adding to the COVID-19 pandemic is the outbreak of migratory desert locusts, further threatening fragile food security in Africa and trapping households in poverty.

Poverty traps can be defined as a self-reinforcing or spiralling mechanism in which the poor make economic choices that make it difficult for them to escape poverty (La Ferrara, 2019). Traditional economic theories and analyses have shown that these traps are driven by factors that can be considered external to an individual, such as climate change, fragility, health, malnutrition, conflict, lack of infrastructure, gender inequality, and deep-seated barriers such as over-reliance on natural resources (Dasgupta and Ray, 1986; Banerjee and Newman, 1993; Beegle and Christiaensen, 2019; Zimmerman and Carter, 2003).

More recently, attention has shifted to the internal constraints of poverty (Lybbert and Wydick, 2018; Banerjee and Mullainathan, 2010) Another aspect of this relates to the behavioural poverty trap. Here, it is increasingly recognized that households' current poverty status has implications for individual psychological attributes and non-cognitive skills such as aspirations, hopes, self-efficacy, self-control, and locus of control (Haushofer and Fehr, 2014; Mani et al., 2013). Brittle social structures associated with poverty stifle the dreams of poor households and imposes

mental burdens on the poor leading to a self-reinforcing loop void of aspirations for a better future.

A specific form of internal constraint arises from aspirations (Appadurai, 2004; Ray, 2006). Aspirations are defined as goals that individuals invest time, money, and effort to achieve (Bernard and Taffesse, 2014). They are future-oriented and exclude satisfaction at the present level. They are also conceptually different from expectations. While aspirations are idealistic, expectations are realistic, implying that aspirations need not be rational (La Ferrara, 2019). The seminal work of Appadurai (2004) opened up interest in understanding and modelling aspirations. He brought forth the concept of 'capacity to aspire', in which he differentiates between the rich and the poor based on their capacity to aspire and relates this to the future-oriented logic of development. He argues that the poor start with lower aspirations, which leads them to invest only marginally, even in outcomes with proven high returns. Such economic behaviour can perpetuate their economic disadvantage and keep them trapped in poverty. Ray (2006) further developed these ideas and introduced three concepts that are important for understanding aspirations and their link to poverty: aspiration window, aspiration gap and aspiration failure.

An aspiration window is a multidimensional concept that captures the opportunity space from which aspirations are formed. It involves an individual's cognitive world and includes a zone of similar and relatable individuals from which aspirations are formed or built (Ray, 2006). This concept reinforces and embodies earlier ideas of Appadurai (2004, p.68) that 'aspirations are never individual but are formed in interaction and in the thick of social life'. Ray (2006) further related the aspiration window to collective action, where he postulated that collective action can be a

pathway that can significantly and consciously influence the capacity to aspire. He identified three ways through which collective action could influence aspirations: (1) groups as internal facilitators of information; (2) groups as external facilitators of information; and (3) groups as coordination devices. Depending on an individual's aspiration window and current status, he or she may have low or high aspirations. The difference between current status and aspired-to status is what Ray (2006) calls the aspiration gap. It is this gap, rather than aspirations per se, that influences future-oriented behaviour (Ray, 2006). Depending on the size of the gap, individuals will either put in the required effort necessary to achieve their aspirations or resign themselves to frustration and make no effort. This forms the basis for the inverted U-shaped relationship between the aspiration gap and future-oriented behaviour (Genicot and Ray 2017, 2020). Aspirations that are ahead of the current status quo, but not too far ahead, serve as the best incentives for investment and savings. This leads to the concept of aspiration failure, which is simply a combination of fatalism and frustration (Janzen et al., 2017). While households with low aspirations may be fatalistic about their future and fail to make necessary investments, households with very high aspirations may also fail to invest due to frustration with the high investments required. Based on the pioneering work of Appadurai (2004) and Ray (2006) and the growing theoretical and empirical literature, several questions arise, which we explore in this thesis.

This thesis provides new insights into the formation of aspirations and their relationship with welfare outcomes. In advancing the empirical literature, we seek answers to the following questions, which represent the different main chapters of the thesis following this introduction:

1. What is the impact of ecological shocks on aspiration formation?
2. How does collective action affect the income and asset aspirations of smallholder households?
3. Are there gender differences in the parental aspirations for children, and does religiosity play a role?
4. What is the relationship between the income aspiration gap and livestock?
5. What are the different strategies households use to reduce food and nutrition insecurity due to COVID-19?

First, the studies on which this thesis is based begin by understanding the formation of aspirations as measured along five dimensions (income, assets, livestock, education and social status) and an aspiration index under the premise that shocks can affect capabilities (Barrett et al., 2019). Here, we understand how ecological shocks affect aspiration formation as measured along all these dimensions, and how those shocks affect the aspiration index. To disentangle the relationship between shocks and aspirations, we explore the behavioural poverty-trap literature. From there, we explore the social determinants of aspirations by following Ray (2006) and examine how collective action triggered through membership in cooperative groups influences income and asset aspirations. In doing so, we test the mediating influence of role models as argued in the literature (Bernard et al., 2019; Beaman et al., 2012). Moving from financial aspirations to human-capital-development aspirations, and in line with the growth of religious

entrepreneurism in many parts of Africa, we consider and examine how a salient variant of the aspiration window – religiosity – influences parents' educational aspirations for their children. Then, with some empirical understanding of aspiration formation, we test the theoretical prediction that aspirations that are ahead, but not too far ahead of people's current situations serve as a stimulus for improving socio-economic outcomes. Given that our study area is a pastoral community where livestock represents rural wealth, and consistent with the Sustainable Livestock 2050 initiative, which seeks to steer livestock development as a pathway out of poverty and food insecurity, we consider livestock as a household investment opportunity. In the final part of the thesis, we consider the COVID-19 shock that suddenly hit the world in 2020. We elicit and highlight the different control strategies that households use to cope with COVID-19-related food and nutrition insecurity.

1.2 Data sources and methodology

1.2.1 Data sources

This dissertation uses three different data sets across the five main chapters following this introduction. In the first four studies, we rely on a cross-sectional household-level survey of 530 smallholder households in Baringo county, Kenya. The survey was based on a multi-stage sampling technique and implemented with support from the Kenyan National Bureau of Statistics in 2019. For the final chapter, we use two different data sets. We combine a cross-country cross-sectional household survey in Kenya, Namibia, and Tanzania collected in 2019 with a phone-based survey we conducted in the same countries at the start of the COVID-19 pandemic. In the original survey, we reached about 2,227 households. The follow-up

survey was limited to 1935 households owning a mobile phone and of these 1,754 households consented to participate.

1.2.2 Methodology

To measure aspirations, we used the reliable and validated measurement instrument of Bernard and Taffesse (2014), which was also used by Janzen et al. (2017). It measures aspirations by directly asking households about their aspirations along various dimensions (i.e., income, assets, education and social status) and aggregating them into an index. Given that the study region is a pastoral area and livestock plays a diverse role in such communities, we added a dimension for livestock aspirations.

Econometric regression-type techniques are at the core of how we address the research questions in the main chapters. In the first study (chapter 2), the relationship between income shocks and aspirations is analysed using both Ordinary Least Squares (OLS) and Instrumental Variable (IV) estimators. In the second chapter, we again used OLS and IV estimators to understanding the relationship between cooperative membership and income and asset aspirations. Additionally, we used the Doubly Robust estimators such as the Inverse Probability Weights (IPW), Inverse Probability Weighted Regression Adjustments (IPWRA), and the Augmented Inverse Probability Weights (AIPW) to robustify the results. The third chapter used the IPWRA and multivalued treatment effect models to understand the relationship between religiosity and parental aspirations for children. To test the inverted U-shaped relationship between aspirations and livestock, we used OLS models and applied different U-shaped tests (Lind and Mehlum, 2010) to verify the presence of aspiration failure in rural Kenya. Finally, we used descriptive and multivariate probit models with some correlation analyses to

elicit the interrelationship between the different strategies households use to reduce food and nutrition insecurity in Kenya, Namibia, and Tanzania.

1.3 Contribution of individual chapters

This section summarizes the five main chapters of the dissertation. Reference is made to the gaps in the various pieces of literature that are addressed.

1.3.1 Aspiration formation and ecological shocks in rural Kenya

This chapter examines the relationship between income shocks (induced by the effects of an ecological shock) and aspirations in terms of income, assets, livestock, education, social status, and the effects of those shocks on an aspiration index. Ecological shocks here refer specifically to the spread of three invasive species, *Prosopis juliflora, Parthenium hysterophorus,* and fall armyworms (FAW). Generally, ecological shocks reduce aspirations. These results are robust to the inclusion of various household characteristics and other controls. In addition, we explore a mechanism that drives the negative relationship between shocks and aspirations. Here we find evidence that ecological shocks could lead to economic adversity that negatively affects aspirations.

These findings contribute in two main ways to the literature. First, they add to the research linking aspirations to behavioural decision-making and economic outcomes. Here, we add to an understudied component thereof that addresses questions of how aspirations are formed or eroded. In particular, we show that shocks can reduce aspirations to a large extent. We study two ecological stressors (*Prosopis juliflora, Parthenium hysterophorus)* and one ecological shock (FAW) that pose a short-term

threat to income, similar to the floods studied by Kosec and Mo (2017). Unlike Kosec and Mo (2017), all three of the threats represent longer-term constraints on productivity and therefore can affect farmers' future expectations not only by limiting current income and assets but also through concerns about future income streams.

A second contribution of this chapter is the confirmation of the link between economic and psychological well-being. This link represents the first part of the feedback loop through which poverty is self-reinforcing through its effects on psychological outcomes (Haushofer and Fehr, 2014). Given that many people in rural communities live below the poverty line, the negative impact of their current status on psychological outcomes can lead to adverse economic behaviour. Of course, this feedback loop can persist and delay escape from poverty if it is strong. While we have provided empirical evidence on the first part of the feedback loop, it may be worthwhile to obtain more evidence on whether psychological well-being can also lead to potentially beneficial economic behaviour. This is highly relevant from a policy perspective, given the increasing reliance on 'light-touch' interventions to improve economic outcomes (McKenzie et al., 2021; Bernard et al., 2019).

Concerning the first part of the feedback loop, the direct consequence, as highlighted in the literature so far, is to offer households material support to improve their livelihoods and welfare. Such support mechanisms have the potential to protect households from the harmful effects of shocks. For example, Kosec and Mo (2017) found that government relief support mitigated the negative effects of floods in Pakistan, which greatly reduced citizens' aspirations initially. Such relief programs not only restore livelihoods and replace damaged assets but also have lasting effects on

psychological outcomes. Thus, boosting individuals' aspirations by easing their liquidity constraints can be a way to improve their economic decision-making.

1.3.2 How does collective action affect the aspirations of smallholder households?

This chapter explores the formation of income and asset aspirations in the context of peer groups, specifically cooperative membership. It builds directly on the conceptualization of Ray (2006), who suggest that improving the capacity to aspire depends on collective action or group membership. He identifies three channels through which this can occur. First, groups serve as information hubs where information can be easily disseminated to members. Groups can serve as repositories for information gathered from numerous sources and shared internally with members. Second, similar to the benefits of economies of scale, groups can communicate and advocate more easily and reliably than individuals. Their numerical strength signals greater trust and credibility, making them more relevant as external conveyors of information. Finally, in the light of a multiple-equilibrium scenario, groups can function as coordination devices. This succinctly summarizes a feature of group effectiveness.

We empirically estimate the effect of cooperative membership on income and asset aspirations. Using different model specifications and estimation strategies to control for self-selection, I find that cooperative membership is positively correlated with smallholder farmers' income and asset aspirations. Using different mechanism frameworks, including sequential g-estimation (Acharya et al., 2016), we show that exposure to role models is the mechanism by which cooperative membership increases aspirations. When households participate in cooperative groups, they are exposed to

reference leaders and role models that can increase their aspiration window and improve their aspirations. The effect of role models on aspirations is well documented in the literature (Bernard et al., 2019; Beaman et al., 2012). Social exposure further enhances information flow, allowing individuals to engage with a range of investment options to achieve stated goals.

Our findings offer new empirical insight into the important role of cooperative groups in increasing aspirations mediated by exposure to role models in the context of a rural setting. These agriculture-based social constructs are widespread in SSA and their importance to villagers is immense, as they promise social and economic mobility within the practical reach of individuals. Based on our findings, we support the development of financial and institutional mechanisms that can increase households' access to cooperative membership, as this offers the possibility to expand their aspiration window and subsequently improve their aspirations. In this regard, programmes and interventions that address external constraints can help reduce the constraints that most rural households face in accessing information that expands their reference set and aspirational window. Addressing these external constraints can go a long way toward offsetting and changing the internal constraints (i.e., lack of aspirations) that households face in improving their future-oriented outcomes.

1.3.3 Religiosity and parental education aspirations for children in Kenya

In this chapter, we investigate how to stimulate aspirations to improve development outcomes. We consider another important aspect of the aspirational window, namely the role of religious institutions and the extent of religiosity. To capture religiosity, we use an assessment of religiosity that

measures the extent of religiosity based upon the current stock of religious practice. In contrast to some individuals being exposed to a certain measure of religiosity and others not, we assume that all individuals have a particular stock of religious beliefs, but the intensity may vary. Therefore, we assess individuals along this intensity continuum by generating a religiosity index based on several questions that measure the extent of beliefs and religious practice. This helps to evaluate the role of religion as measured along both an extensive and intensive dimension (religious institutions and religiosity, respectively).

We used gender-separated vignettes to capture parents' educational aspirations regarding their children. The use of vignettes prevents parental favouritism and biases in parents' evaluations of their children. This is because vignettes are used to elicit complicated household dynamics, such as intra-household decision-making (Bernard et al., 2020). Because we ask each household about its assessment of educational aspirations for boys and girls, we can observe differences between genders. We find a positive association between participation in religious institutions and religiosity on educational aspirations for children, with a stronger effect for girls. We speculate that this effect may be driven by religious role models and the potential of religious institutions to cater for the less privileged. The role-model postulation is in line with previous studies reporting a positive effect of role models on girls' aspirations (Beaman et al., 2012). The possible 'girl effect' is further strengthened by historical evidence of the influence of religion on women's education and economic outcomes (Meier zu Selhausen, 2014).

This chapter offers three main contributions to the emerging literature on the role of religion as a psychological input in the achievement of development

interventions. First, it provides empirical evidence of the relationship between religiosity and parents' educational aspirations toward their children. The contribution explores a component of Ray's (2006) aspiration window concept by modelling religiosity. Second, while children always have aspirations for their future outcomes, parents also have aspirations for their children (Serneels and Dercon, 2021), even with a stronger effect as compared to those of the children, possibly due to the parents' role in intra-household and inter-household allocation of resources. Understanding parental aspirations for their children may be particularly important for economic development and poverty alleviation. This is even more relevant given that about 50 percent of the poor in Africa are youths under the age of 15 (Beegle and Christiaensen, 2019).

Finally, beyond gaining an understanding how educational aspirations are formed, we go a step further by examining differences between aspirations from a gender perspective. Parents may aspire differently for their children based on gender (Bernard et al., 2019). This may be exacerbated due to different cultural and ethnic lines, values, and norms, as well as livelihood options. We thus provide insights into the formation of parental educational aspirations for their children, which currently comprise a rather sparse segment of the aspirations literature.

1.3.4 Turning from good to bad: Aspirations and livestock in Kenya

This chapter tests the theoretical prediction that aspirations ahead of the current status quo, but not too far ahead, serve best to incentivize people to invest and save to achieve these aspirations. This provides the basis for the inverted U-shaped relationship between the aspiration gap and savings suggested by theory (Genicot and Ray 2017, 2020). We examine the

income-aspiration gap of smallholder households and relate it to livestock. The focus on livestock is guided by the increasing recognition of livestock as an investment and savings vehicle for many households in pastoral communities in developing nations. Consistent with theoretical predictions, we find that aspirations increase with livestock up to a threshold aspiration point, from which they then decline. This result was confirmed by several U-shaped tests following Lind and Mehlum (2010), suggesting the presence of aspiration failure. To determine which livestock might be most important for investment and savings, we performed a heterogeneity analysis and found that cattle play a greater role than other livestock. The results are robust to the inclusion of various covariates, truncations at zero, and the transformation of livestock savings. We also show that it is unlikely that the results are driven by unobserved heterogeneity. Going beyond the concept developed in the Genicot and Ray (2017), we show that the locus of control may well mediate the relationship between aspirations and livestock savings. High aspirations may reduce the degree to which individuals believe they have control over their lives. This reduction in belief could adversely influence the actual livestock a household keeps.

We contribute to the literature on aspirations and future-oriented behaviour in four main ways. First, we add empirical evidence by directly testing the relationship between aspirations and household investment and savings. The literature (Genicot and Ray, 2020) on this is growing but the results are mixed (Bloem, 2021). While earlier analyses reported no significant relationship between aspirations and investment (Pasquier-Doumer and Brandon, 2015), more recent analyses point to its existence (Bloem, 2021). McKenzie et al. (2021) even applied experimental methods to credibly identify the relationship between aspirations and financial decisions among poor entrepreneurs in the Philippines. The second contribution comes from

our outcome measures, namely livestock investment and savings. Our study is the first to examine the relationship between aspirations and livestock savings. In many arid and semi-arid regions of SSA, livestock ownership can be considered a comprehensive measure of rural welfare, as it serves to provide various services and products, including nutritious food, insurance, wool, and traction power. Many governments in Africa and Asia, with support from organizations such as the United States Agency for International Development (USAID) and the Food and Agriculture Organization (FAO), are stepping up efforts to increase livestock production under the framework of the Africa Sustainable Livestock 2050 initiative. The findings here suggest that improving the aspirations of smallholder households may be a step in the right direction toward achieving this as one of the conduits for this major transformation. Third, we reinforce the role of other psychological and internal factors such as agency and locus of control in explaining this non-linear relationship between aspirations and savings. Individuals who have a higher agency and believe in their ability to change outcomes in their lives may have a higher turning point and invest more than those with a low level of agency. Finally, we also contribute from a regional perspective by providing novel evidence on aspirations from SSA. To our knowledge, there has been no direct test of this inverted U-shaped relationship in SSA. Most of the previous studies are limited to Asian countries such as Nepal, Myanmar, India, Nicaragua, Colombia, Pakistan, the Philippines, and Kyrgyzstan.

1.3.5 Coping with COVID-19 in rural Africa: An analysis of household-level coping strategies in response to food insecurity in Kenya, Namibia, and Tanzania

This chapter dives deep into the topic of coping with shocks by examining the different strategies that households use to ensure food security following

the advent of the COVID-19 shock. First, we provide an overview of the state of food security during COVID times and the extent of COVID-19 related food disruptions. The COVID-19 pandemic began to spread around the world at the end of 2019 and throughout 2020 after it was first reported in Wuhan, China, in late 2019. To prevent the spread and collapse of health infrastructures, many governments imposed lockdowns, curfews, social distancing, and travel restrictions. These restrictions have demonstrably led to income shocks through a reduction in informal employment, particularly in Africa, where households typically depend on the informal sector and agricultural activities for their livelihoods. This has led to food and nutrition insecurity in Africa (Laborde et al., 2020). Against this backdrop, households have relied on various management strategies to reduce their food-insecurity status.

Using a phone-based survey conducted in the midst of the COVID-19 and locust shocks, and in combination with an earlier cross-country household survey in Kenya, Namibia, and Tanzania, we document the extent of food insecurity in the three rural regions of our study countries. We find that over 42 percent of the sampled households had gone without food for at least one day over the previous 30 days. Over 70 percent were concerned about running out of food soon and not having the means to obtain food.

Second, we shed light on interruptions in food access and interruptions in agricultural activities related to COVID-19 prevention activities. We find that the most common disruption was increased food prices. Households responded to food-access interruptions by reducing their food intake, diversifying their food sources to include less nutritious foods, and intensifying food procurement. Households also relied on strategies outside their control, such as food support from the government and friends. We

provide evidence of complementarities as well as synergies in the use of these options. Overall, households significantly reduced their food intake and resorted to less nutritious foods, confirming previous claims that the COVID-19 pandemic had deleterious effects on food and nutrition security (Laborde et al., 2020).

In this chapter, we contribute to the scant literature on household coping mechanisms to COVID-19. To our knowledge, this is the first study to examine strategies to counter the COVID-19 in African countries. Consistent with the evolving literature on the negative impacts of COVID-19 on food and nutrition security, we report significant complementarities in the use of all strategies, which has direct policy implications. A robust observation from this complementarity is that despite the use of one of the strategies, reductions in food intake were a constant, and to a lesser extent so was the use of less nutritious foods. This supports the growing descriptive literature demonstrating the deleterious effects of COVID-19. Added to this are the various coping strategies used to reduce these effects.

1.4 Limitations and outlook

Despite the relevant findings and contributions of this dissertation to the growing literature on aspirations and future-oriented behaviour, some limitations of the study may open up ideas for future research. The first limitation stems from the use of cross-sectional data. Throughout the dissertation, we try to avoid making causal statements and caution the understanding and interpreting the results as associations because of the identification issues associated with cross-sectional data. Future research

may seek to understand aspirations using panel data or through experimental setups[2] (Bernard et al., 2019; McKenzie et al., 2021). In some chapters, we used different estimation techniques such as IV estimators as well as double robust estimators to reduce selection bias and unobserved heterogeneity. In chapter 4, we followed the procedure of Oster (2019) to quantify omitted variable bias, and estimated how large this would need to be to explain away the inverse U-shaped relationship between aspirations and livestock savings.

We also measure aspirations for income, assets, livestock, education, and social status. While these represent to a large extent what households in rural areas aspire to, they may not fully reflect household aspirations. Health, security, and environmental sustainability are other dimensions along which households' aspirations might be measured. It could be interesting to understand how aspirations regarding these other dimensions are formed and lead to future-oriented behaviours. One particularly interesting idea here is to model the relationship between aspirations and anti-social behaviours such as crime, conflict and terrorism (Ray, 2006). Of course, failed aspirations can lead to such dismal behaviours, but conflict could also lead to fatalism due to low aspirations.

Finally, the analysis may be limited in terms of external validity since we considered a single case study, Kenya, and additionally Namibia, and

[2] It suffices to mention here that potential caveats should be considered when using experiments to understand aspirations. Any intervention that exogenously increases aspirations to understand the relationship between aspirations and savings/investment could leave households worse off if the predicted inverse U-shaped relationship exists. Such interventions involve immense ethical concerns because they can harm households' investment and saving behaviours in the long run. This was the case in the Phillippines, where exogenously induced financial aspirations led to reduced borrowing and business investment by poor entrepreneurs (McKenzie et al. 2021).

Tanzania for the final chapter. Since context matters, future studies should offer empirical perspectives from different case studies and study areas. Nonetheless, it may be appropriate to guide the understanding of the findings from an African smallholder farm sector, as the policy environment of these countries is very similar. Moreover, farmers in most of these countries face similar production, livelihood, and welfare constraints.

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Chapter 2

Aspiration formation and ecological shocks in rural Kenya[3]

Abstract

Aspirations have been shown to affect households' decisions around productive investments, but little work has explored how aspirations are formed or eroded, especially in the face of ecological threats. While ecological threats may erode social and economic capital, there is no consensus on their effect on internal factors such as aspirations. We use the spread of three invasive species as our measure of ecological stressors and shocks. While all three reduce productivity, two of these invasives are slow-moving, and one fast: *Parthenium*, *Prosopis*, and Fall Armyworm (FAW) respectively. We ask how exposure to these stressors and shocks affects aspirations about income, assets, livestock, social status and education as well as an aspirations index. Employing primary data from 530 smallholder households in northern Kenya, we find that ecological stressors –

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specifically, *Prosopis* – are correlated with lower aspirations. The effect of ecological stressors on wealth is the mechanism through which this happens. Our findings offer suggestive evidence of the concept of the 'capacity to aspire', which hinges on one's material endowment and relates to the future-oriented logic of development.

Keywords: Aspirations, ecological shocks, stressors, invasive species, aspiration index, Kenya

JEL classification codes: C36, D31, D90, D91, P13

2.1 Introduction

High aspirations may bolster the poor through misfortune and difficulties in their quest for better livelihoods. Many interventions to promote development in rural areas have been unsuccessful because of an imperfect understanding of the desires, expectations, and aspirations of the rural people. A case in point is the low level of adoption of proven improved farm inputs, techniques and innovations in developing countries (Mausch et al., 2018). Inspired by their direct link to poverty and relevance for specific agricultural interventions especially in rural areas, economists are increasingly studying aspirations. Aspirations have been shown to matter for human capital investments (Beaman et al., 2012; Bernard et al., 2019; Serneels and Dercon, 2021), food security (Mekonnen and Gerber, 2017), and adaptive capacity by shaping risk management (Rao et al., 2020). Low aspirations and fatalism have been identified as contributing to reduced investments and can lead households to fall into a poverty trap (Macours and Vakis, 2014; Laajaj, 2017).

In their bid to increase production and improve their livelihoods and welfare conditions, households face a plethora of shocks. These shocks could either be idiosyncratic or systemic and threaten yields of arable crops or pasture productivity. This drop in productivity likely reduces current and future income as well as the value of agricultural assets. In Kenya, the recent spread of three invasive species: two plants *(Prosopis juliflora*, *Parthenium hysterophorus)* and one insect (Fall Armyworm), has caused substantial economic harm. In assessing the economic value of dryland ecosystem services affected by *Prosopis*, Bekele et al. (2018) find that households were willing to pay $37.74/year for the management of *Prosopis*, likely due to the loss of productivity and ecosystem services. *Parthenium* is estimated to be

responsible for $51.4 to $81.9 million in losses, annually in Eastern Africa (Pratt et al., 2017). These losses were projected to increase from $139.4 to $195.3 million in a 5-10 year period following 2016. In Kenya particularly, current annual losses stemming from Parthenium infestation are estimated to range from $3.8 to $7.7 million while the predicted future losses range from $19.1 to $28.7 million (Pratt et al., 2017). With regards to Fall Armyworm (FAW), De Groote et al. (2020) reported that FAW reduced Kenyan maize yields by a third, causing loss of a million tonnes of maize in 2018. These shocks all directly affect current income, but can also portend future productivity losses. While these threats require a coordinated response to evaluate their impact, it is important not only to understand how they affect current outcomes, but also how they affect aspirations and future investments.

We use primary household-level data from Kenya to understand the relationship between ecological threats and aspirations. Kosec and Mo (2017) provide a first attempt to shed light on whether environmental threats affect aspirations by analysing floods in rural Pakistan. They report a negative effect of floods on the aspiration of households, with the greatest effect being felt by poor and agriculture-dependent households. We build on their analysis by examining the formation of aspirations under ecological stressors and shocks; specifically invasive species. In doing so, we explore possible mechanisms that may underly the relationship between ecological shocks and aspirations. We test whether these shocks affect incomes and assets, which reflects the 'capacity to aspire' concept of Appadurai (2004). Using invasive species as ecological stressors enables us to worry less about endogeneity concerns as our invasive species pressure can be considered relatively exogenous to the determinants of rural aspirations. However, to address some of the residual endogeneity between ecological shocks and the

aspiration measures, we also employ an instrumental variable approach for robustness.

The study offers the following contributions: firstly, it adds to the aspiration literature by providing empirical evidence regarding the formation of aspirations under an ecological threat. We study two ecological stressors and one ecological shock (FAW) which pose a short-term threat to income, similar to floods studied by Kosec and Mo (2017). Unlike Kosec and Mo (2017), all three threats we study may impose longer-term constraints on productivity and may therefore affect farmers' expectations for the future, not only by limiting current income and assets but also by prompting concerns about future income streams. Given that not all shocks are the same, our main contribution here stems from the fact that we consider three types of invasive species. Secondly, we follow the well-tested instrument for measuring aspiration designed by Bernard and Taffesse (2014), but add livestock as an additional dimension of aspiration to fully capture the rural wealth level of households. As the study area is a pastoral community, livestock represents rural wealth to a considerable extent. In these communities, livestock serves as a measure of status and acts as a means of saving. Livestock are also a productive asset in and of themselves, providing multiple services and commodities including traction power, insurance, wool (in the case of sheep) and a source of nutritious food (Aryal and Holden, 2012). Their droppings are usually used to produce farmyard manure (Debela, 2017) which is used to improve agricultural productivity. Livestock also signify and exhibit some cultural values and attributes as they are offered as dowry and presented as gifts during weddings. In this respect, livestock aspirations encompass several dimensions of aspiration.

Finally, we evaluate all five dimensions of aspiration separately and further examine underlying mechanisms. To our knowledge, this study is the first to investigate what drives aspiration formation along each of the quantitative dimensions of aspiration. Potentially, the dimensions along which an individual could aspire are infinite; however, income, wealth, education, and social status are the central dimensions that capture a large share of what the rural poor aspire to, particularly in low- and middle-income countries. Most previous studies (Stutzer, 2004; Knight and Gunatilaka, 2012; Janzen et al., 2017; Kosec and Mo, 2017) only analyse the formation of aggregate aspirations (index approach) or look at the dimensions separately, in which case they focus on at most two dimensions.

The rest of the study is organized as follows: Section 2.2 provides a background overview of ecological shocks and invasive species in Kenya. A conceptual framework that links ecological threats to aspirations is also developed in this section. Section 2.3 presents the farm household survey, data collection, and measurement of variables, while the empirical strategy is presented in the section 2.4. The descriptive and empirical results, as well as the tested mechanism, are presented in section 2.5. The article concludes in section 2.6.

2.2 Shocks and aspiration formation

2.2.1 Ecological shock – Invasive species in rural Kenya

Invasive plants and animals are an increasing threat to agricultural production, reducing the yields of crops and pasture. They pose a particular hazard to smallholder farmers and ranchers who may have limited tools to mitigate the damage they cause. They also present a threat to ecosystem

functioning, biodiversity and habitat as they out-compete both planted and natural vegetation (Bekele et al., 2018). While they are non-native to Africa, their spread and incidence are increasingly reported in many African countries, with visible impacts on livelihoods and the environment. Their fast spread and impact can be attributed to allelopathy and competition, allergic response, hypersensitivity inducement, rapid growth, pollen swamping and easy mode of transportation (CABI, 2019). The incidence of these invasive species often forces changes in livelihood beyond losses in crop production, affecting the prospects of households (Pratt et al., 2017). For instance, school-age children may be forced to sacrifice school to spend considerable time managing these invasive species through methods such as weeding, cutting, pruning, and spraying.

As highlighted in the introduction, we consider three invasive species currently impacting the livelihoods of farmers in Kenya: *Prosopis*, *Parthenium* and FAW. *Prosopis* is a shrubby woody plant native to South America. It was among the plant species introduced to Kenya in 1983 by the Food and Agriculture Organization (FAO) to rehabilitate the Arid and Semi-Arid Areas (ASALs) from increasing deforestation, desertification, soil erosion and salinization, and to protect households from wind and dust storms (Mwangi and Swallow, 2008). The plant was also introduced for fodder, honey production, shades, windbreaks, fuelwood, firewood, and construction materials, with a general objective of improving the livelihood options of households (Mwangi and Swallow, 2008). Over time, its pods have been used as feed to livestock and occasionally by humans. However, after establishment, the trees quickly invaded agricultural and rangeland areas, reducing pasture and farmland productivity (Mwangi and Swallow, 2008). The tree has also degraded ephemeral wetlands and irrigation canals,

leading to the death of livestock, causing floods and reducing livestock (meat) quality.

In Kenya, these species were specifically introduced in the Marigat division of the Baringo county stretching from Lake Baringo towards Lake Bogoria. Marigat is a lowland area where the invasion of *Prosopis* can easily be observed. Using Landsat satellite data, Mbaabu et al. (2019) report an increase in *Prosopis* coverage from 882 hectares in 1988 to 18,792 hectares in 2016 and found that *Prosopis* directly accounted for over 30% of the land-use and land-cover changes in grasslands, irrigated croplands, rainfed croplands and vegetation. Their work suggests that *Prosopis* is a key driver of the observed land-use and land-cover changes in the Marigat division of Kenya. In 2005, the rural population, frustrated by dwindling grazing lands stemming from the *Prosopis* invasion, filed a lawsuit against the national government of Kenya for the introduction of *Prosopis* in the area.

Parthenium is an annual herb native to Central and South America, Mexico and the Southern United States which has increasingly become a rangeland weed in Asia and Africa (CABI, 2019). It affects crops, livestock and biodiversity, with effects on animal health and human livelihoods. The effect of *Parthenium* on crops and forage plants is due to its highly competitive and allelopathic nature which inhibits the growth of a wide variety of crops. Moreover, it also acts as a secondary host for other pests that attack arable crops such as maize, sorghum and beans. It negatively affects livestock production by reducing grazing land as it encroaches and replaces forage plants, reducing the forage intake of livestock. When animals feed on *Parthenium*, it leads to poor-tasting meat and low milk quality as well as intestinal damage, anorexia and dermatitis (CABI, 2019).

From an environmental perspective, *Parthenium* leads to a loss of biodiversity through a disturbed food chain.

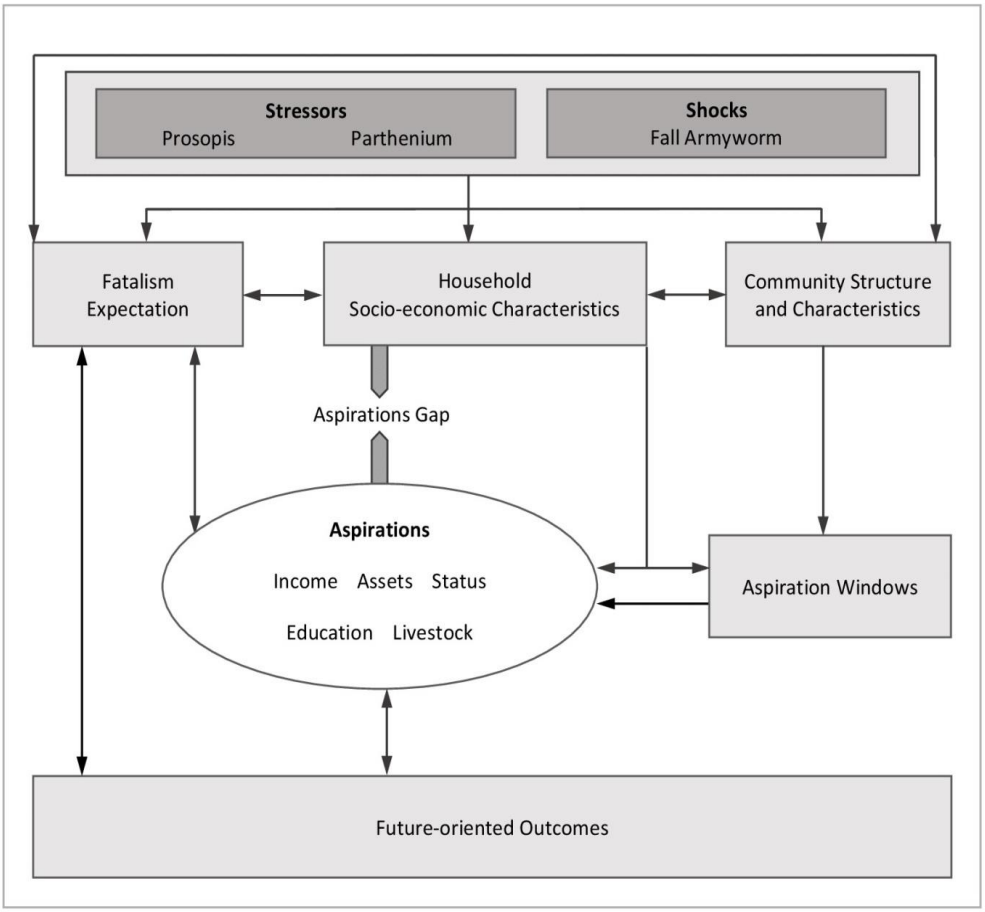
Fall armyworm (*Spodoptera frugiperda* J: E Smith*)* is a crop pest first reported in Africa in late 2016 which quickly spread across sub-Saharan Africa (FAO, 2018). Native to the Americas, the pest preferentially feeds on staple crops such as maize, but will also consume wheat, sorghum, and millet as well as rice and vegetable crops (De Groote et al., 2020). It damages plants by attacking their vegetative growing areas and burrowing into the cobs of older plants, reducing both the quality and quantity of the harvested plants. FAW is a migratory pest with a high dispersal capacity that spreads rapidly among its host plants. It has a varying life cycle of 30-80 days depending on the season of the year (Baudron et al., 2019). The warmer the season, the less time it takes to complete its life cycle. Kenya's semi-arid environment, with an extended dry season, is unfortunately highly suitable for FAW, leading to its high incidence since its arrival.

For an agrarian economy like Kenya where maize is an important staple crop providing food, feed, and income to rural households, the invasion of FAW is a threat to food security and detrimental to rural livelihoods (Kassie et al., 2020). From a household-level perspective, FAW directly affects the income level of households through yield losses and increased cost of production. It also increases farm efforts and the labour costs needed to additionally deal with the pest, making it a threat to maize production with a substantive negative impact on food security and welfare in Kenya.

2.2.2 Conceptual framework

Here, we present a simple framework to structure our thinking about the effects of ecological shocks on aspirations and identify possible underlying mechanisms. We see several possible mechanisms: (1) since ecological stressors and shocks affect individual productive activities and thereby economic outcomes, goals that were previously viewed as achievable may no longer seem reachable, causing individuals to adjust their aspirations downward; (2) severe ecological stressors and shocks may increase fatalism in plain sight of the related, emerging risks that increase the probability that investments may not pay off in the future. This perception of increased risk could reduce the aspiration associated with large (and risky) investments; (3) ecological stressors and shocks may also impact the community's social and communication structure, which in turn may affect individual aspirations. For instance, approximately 30 years after the introduction of *Prosopis* in the Baringo county of Kenya by the Food and Agriculture Organization (FAO) with the consent of the government, the rural population filed a lawsuit against the government for introducing this plant despite the original positive benefit it had at the time of its introduction. The communities were dissatisfied with the extent of its invasion and its negative impacts on both livestock and human livelihoods. Such community efforts can strengthen community bonds and social networks, which can positively affect aspirations.

Figure 2.1 Conceptual framework linking ecological shocks and aspirations



In most rural communities in Africa, agriculture continues to be the mainstay of many households, providing food, income and employment (Dercon and Gollin, 2014). Given agriculture's inherent links to the environment, ecological shocks may have direct consequences on the current income and asset level of households. Thus, we might expect that ecological shocks affect aspirations through their effect on incomes and assets. Zooming in on the effect of ecological shocks on household income, we hypothesize a negative effect between all the invasive species and income. For example, *Prosopis* affects both crop and livestock farmers

negatively, though this could also be seemingly ambiguous given that farmers are increasingly using the trees for charcoal production, which could earn them income. Income from beekeeping could also increase given that bee farmers increasingly suspend beehives on mature *Prosopis* trees (Bekele et al., 2018). The other invasives largely represent negative shocks to farmers as they directly affect farmers' production levels. Figure 2.1 shows the interrelationship between shocks and aspirations. It also guides understanding of the specified pathways linking ecological threats and aspirations. From this, some hypotheses arise, which are tested in the subsequent sections. In particular, we test the mechanism that the current wealth level of households may mediate how ecological shocks affect aspirations.

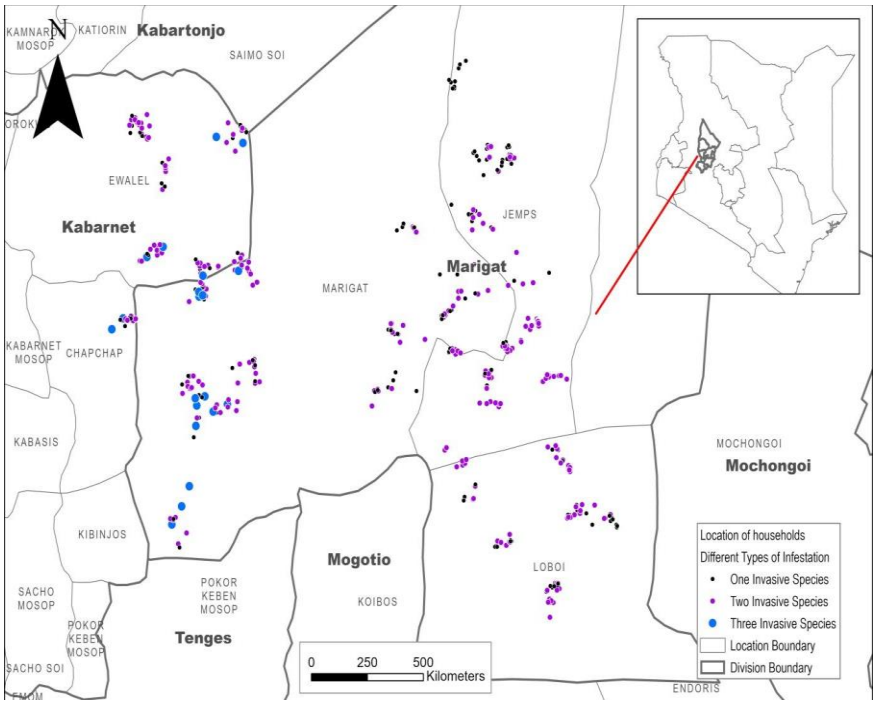
2.3 Data

2.3.1 Household survey design and data collection

A household survey was conducted between July and August 2019 in the Marigat division of the Baringo county of Kenya. Marigat was purposely selected because of the presence and rapid spread of the invasive *Prosopis juliflora* and *Parthenium hysterophorus* coupled with the incidence of FAW. Figure 2.2 shows the reported infestation levels of invasive species in Marigat. We interviewed 530 households from the Ilchamus, Marigat, Mochongoi and Ewalel/Chapchap wards of the Marigat division. We used a two-stage sampling procedure wherein villages served as the primary sampling unit. In the first stage, villages were selected using probability proportional to size sampling (PPS). In the selected villages, a household listing exercise was undertaken where we listed all the households in the various villages with the help of the village heads. In the second stage, 15-16 households were randomly selected and interviewed using a structured

questionnaire. The survey questionnaire was designed using the World Bank's computer-assisted personal interviewing (CAPI) software, Survey Solutions. The survey was administered through personal interviews by a group of research assistants who were trained and supervised by the first author. Interviews were carried out usually with the household head or the spouse in their local language.

Figure 2.2 Infestation levels of invasive species in Marigat, Kenya



Source: Author

The survey gathered information on the aspirations, hopes and ecological threats affecting pastoral farmers. Household-level data were garnered on the three invasive species. Data were also collected on key socio-economic variables, institutional characteristics, shocks, coping strategies, land and livestock ownership, and income and expenditure as well as household asset structure. Table 2.1 describes the main variables used in the analysis.

Table 2.1 Definition of variables

Variable	Definition
Household Income	Total household income ($)
Asset ownership	Total value of all assets ($)
Livestock ownership	Tropical livestock units (TLU)
Flock size	Total number of livestock owned
Age of the household head	Age of the household head in years
Household head is male	=1 if household head is male, 0 otherwise
Education	Number of years in school
Household size	Total number of household members
Dependency ratio	Number of dependents over the active population
Total cultivated land	Total cropland in hectares
Labour	Total labour of all household members (person-days)
Hired labour	Total person-days of labour hired
Village responsibility	Household head has a responsibility in the village
Crop experience	Number of years in crop cultivation
Livestock experience	Number of years of livestock keeping
Extension contact	Number of interactions with an extension agent
Distance to market	Walking distance to the main market (km)
Credit access	=1 if a household has access to credit facilities, 0 otherwise
Mobile money	=1 if a household uses mobile money services, 0 otherwise
FAW infestation	=1 if a household's fields are affected by fall armyworm
Parthenium infestation	=1 if a household's fields are affected by Parthenium
Prosopis infestation	=1 if a household's neighbourhood is infested by Parthenium

2.3.2 Measuring Ecological shocks

We measure ecological shocks based on the infestation of *Prosopis*, *Parthenium* and FAW over the last calendar year. We used a dummy variable to represent this dichotomous relationship where a value of 1 represents infestation and zero otherwise. In the case of FAW, 1 represents FAW infestation, while in the case of *Parthenium*, a value of 1 signifies that fields are infested with *Parthenium*. As *Prosopis* is a rangeland invasive, we rather considered infestation based on the neighbourhood of the household. We define the neighbourhood of a household based on a 10-metre-radius buffer. It was then captured as an indicator variable that takes the value of 1 for *Prosopis* infestation and 0 otherwise.

2.3.3 Measuring Aspirations

Measuring aspirations is a considerable challenge. The multidimensional nature of aspiration requires different measurement scales, rendering comparison and interpretation difficult. The attitudinal nature of aspiration further challenges the comparability across individuals and studies. The use of different expressions, measurement scales, and the heterogeneity of respondents who may interpret wordings differently may induce measurement error. To address these challenges, we apply the Bernard and Taffesse (2014) aspiration framework measuring aspirations along four key dimensions: income, education, social status and wealth (see also Kosec and Mo, 2017).[4] While the income and asset aspirations were captured in monetary terms, education aspirations were captured as the number of years

[4] Note that LaRue et al. (2021) refer to Bernard and Taffesse (2014) as measuring "ambition" instead of aspiration. They understand aspirations as the combination of ambition with the strategy to achieve them.

of education to the parent aspires for their children.[5] For social status aspirations, we used a 10-level status scale with 1 representing the lowest status aspiration and 10 the highest. As our study area is a pastoral community, we added a livestock asset dimension to more fully capture rural wealth aspirations. Here, households reported the actual flock/herd size, which we converted to livestock units. As recommended by Bernard and Taffesse (2014), we used well-trained and experienced research assistants so as not to jeopardize the quality of the aspiration data.

We relied on the self-reporting of aspirations. We asked the following questions (in this order) to control for plausible anchoring effects and set a reliable range for reporting household aspirations for *a* (*a* being the respective dimension of aspiration):

i) What is the maximum level of *a* that an individual can attain in your neighbourhood?
ii) What is the minimum level of *a* that an individual can attain in your neighbourhood?
iii) What is your present level of *a*?
iv) What level of *a* would you like to achieve?

In enumerator training, we particularly focused on the difference between aspirations and expectations.[6] While aspirations are future-oriented and

[5] Here, we introduced gender-separated vignettes to capture aspirations for any child below 10 years of age and used fictional children instead of the actual children a household has.

[6] To be sure that we captured aspirations instead of expectations, we used the Bernard and Tafesse (2014) aspiration framework but translated it during the enumerator training and made it more locally adapted. This was done through extensive discussion with the enumeration team. We also did many pretestings to be sure about this outcome. From the

idealistic, and consider one's life goals, expectations are more limited and realistic, and refer to what an individual thinks is more likely about his life after considering potential constraints. A household with a low-income status may be unlikely to expect to increase its income after observing the income of others and considering their income-generating potential. However, this household may still aspire to increase its income.

We expect all five measures of aspirations to be positively related, which would also justify aggregating them into one aspirational index. Despite reducing information along each dimension of aspiration, aggregation controls for measurement error common in attitudinal variables by reducing stochastic noise. First standardization is carried out at the ward level by subtracting the ward's sample average from the aspiration level of each individual in the ward and then dividing by the ward's standard deviation. Then the standardized individual scores are averaged across the aspiration dimensions. Representing an individual's actual aspiration level for dimension a as x_i^a with A = 5 being the total number of dimensions, the aspiration index level for each individual *i* is expressed as

$$AI_i = \frac{1}{A}\sum_a \frac{x_i^a - \mu^a}{\sigma^a} \quad (1)$$

μ^a and σ^a are the ward's sample mean and standard deviation, respectively.

Individuals differ in how they value the different dimensions of aspirations. While some find educational aspiration for their children more important,

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responses to the questions, we are certain households were stating their aspirations as they were multiples of current levels. This is similar to the aspiration levels captured in Janzen et al. (2017).

others may stress social status or asset level more. Since aspirations are motivators for investing resources (effort), it seems relevant to record how individuals regard the importance of the different aspiration dimensions by weighting. To do this, we play a simple game by giving out 20 maize seeds to households, asking them to distribute the seeds based on how they value a particular aspiration dimension. The weight w_i^a is the share of maize seeds associated with a specific dimension. We can then calculate a weighted aspirations index as

$$AIW_i = \sum_a \left(\frac{x_i^a - \mu^a}{\sigma^a}\right) w_i^a \quad (2)$$

2.4 Measuring the covariation of ecological shocks and aspirations

To determine how aspirations vary with ecological shocks, we estimate the following regression:

$$A_i = \beta_0 + \beta_1 \boldsymbol{ES_i} + \beta_2 \boldsymbol{X_i} + \beta_3 W_i + \varepsilon_i, \quad (3)$$

Where A_i represents the different aspiration dimensions (income, assets, livestock, social status, education) and the aspiration index for household *i*, $\boldsymbol{ES_i}$ is a vector of binary variables indicating infestations with the invasive species (*Prosopis*, *Parthenium*, and FAW), $\boldsymbol{X_i}$ is the vector of explanatory variables and ε_i is the stochastic error term. For estimation, we include village fixed effects, W_i.

Our interest lies in the estimation of β_1 which measures the impact of ecological shocks on the income, asset, livestock, social status, and

educational aspirations as well as the aspiration index. We hypothesize a differential effect on the different aspiration dimensions and the index. Of course, ecological shocks should distinctly affect the different dimensions but as they are correlated, a uniform relationship is expected *a priori.* We consider the spread of ecological shocks as a natural experiment with no household influence. For the income and asset aspiration model, the dependent variable is log-transformed because of its skewed distribution. For the other models, we estimate equation (3) in a linear form.

As the incidence of ecological shocks is stochastic, with very little control from households possible, we worry less about endogeneity issues. Ecological shocks are independent of household aspirations. That said, one might be concerned that the intensity of invasives might be correlated with unobservable factors that are also correlated with aspirations. To address this concern, we use village fixed effects and thus identify the effect of these shocks from differences in the intensity of invasives within neighbouring villages. We also include a wide range of control variables.

2.5 Results and Discussion

2.5.1 Descriptive statistics

We present the descriptive statistics of some of the important variables used in the empirical model in Tables 2.2 and 2.3. While Table 2.2 presents the means, standard deviation, 10^{th} percentile and the 90^{th} percentile of the continuous variables, Table 2.3 presents the frequencies and percentages of the indicator variables. The monthly average household income is approximately $104.50, including income from all sources (crop and livestock activities, salaries, remittances, pension, compensation income and business income). We have three main groups of household assets: total

household assets comprising non-productive assets such as television, furniture, buildings, radios; productive assets such as farm implements, ox and donkey carts, ploughs, tractors, and other tools; and livestock assets which include cattle, goats, sheep, donkeys, camel and poultry. The average value of the asset holding of households is approximately $1,646.70 while the productive assets are valued averagely at $709.60. Livestock ownership is measured as the herd size and converted to tropical livestock units (TLUs) using the Food and Agricultural Organization (FAO) conversion rate where a cow is equivalent to 0.8 TLU, a goat 0.2 TLU, a sheep 0.2 TLU and poultry 0.02 TLU. The mean herd size is estimated at 25 with an average TLU of 3.18.

Household demographic characteristics are captured with variables such as age, education, household size, area of cultivated land, off-farm income, labour, and farming experience. The average age of the household head is 45 years and ranges from 18 to 104 years. While almost one-fifth of the household heads have no formal education, the average number of years spent in formal educational training is approximately 8 years. Household size ranges from 1 to 15 members with an average of 5.94 members per household. The dependency ratio measured as the ratio of the number of dependents (<15 and >65) to the number of the actively working population (15-64) has a mean value of approximately 1. A great majority of the households are either crop farmers or livestock keepers. The average farm size is 0.52 hectares, suggesting that most of the households are smallholders. Apart from cultivating crops and rearing livestock, households participate in other employment activities earning an average off-farm income of $19.90 per year.

Table 2.2 Summary statistics of continuous variables

Variable	Mean	SD	10th percentile	90th percentile
Household Income ($)	104.52	127.97	19.20	216
Asset ownership ($)	1,646.7	10,129	76.57	2,380.56
Productive asset ownership ($)	709.56	8,446.4	9.60	861.12
Livestock ownership (TLU)	3.18	5.07	0	7.85
Flock size (number)	24.74	35.16	0	57
Age of the household head (years)	45.15	15.62	26	70
Education of head (number)	7.89	4.86	0	13
Household size (number)	5.94	2.83	2	10
Dependency ratio	1.17	1.17	0	2.5
Total cultivated land (hectares)	0.52	0.72	0	1.21
Off-farm income ($)	19.99	97.38	0	38.4
Years in village (number)	24.46	18.68	4	54
Labour (person days/year)	51.32	61.62	0	136.5
Crop experience (years)	13.4	13.02	1	30
Livestock experience (years)	17.06	16.14	1	40
Distance to market (km)	9.50	7.79	2	20

Source: Author's calculation from field survey, 2019. Income is reported on a per month basis

Farming experience was also captured with an average crop experience of 13.4 years and an average livestock experience of 17.06 years. Agricultural extension services are not well developed in the study area. Most of the

farmers (26%) are not aware of who/what extension services are. The few who are aware have only interacted with extension agents once on average.

Table 2.3 Summary statistics of indicator variables

Variable	Yes (1)		No (0)	
	Frequency	**Percentage**	**Frequency**	**Percentage**
Household head is male	393	74.15	137	25.85
Village responsibility	89	16.79	441	83.21
Credit access	228	43.02	302	56.98
Mobile money	438	82.64	92	17.36
FAW infestation	390	73.58	140	26.42
Parthenium infestation	211	39.81	319	60.19
Prosopis infestation	386	65.28	184	34.72
Irrigation	128	24.15	402	75.85
Improved seeds	333	62.83	197	37.17

Source: Author's calculation from field survey, 2019

With regards to ecological shocks, about 74% of the sampled households reported an incidence of FAW in their fields, with about 50% of crops being damaged by FAW. For the plant invasive species, *Parthenium* was reported to be new and was described as an 'ambassador'. Its infestation rate was about 40% with less than 10% severity with low damage to crops. This can be attributed to the fact that *Parthenium* only thrives well on plots not extensively managed and along irrigation canals. Though it gets propagated easily because of its tiny seeds, it is easily managed by hand weeding. *Prosopis*, which is mostly found in the lowlands, has an infestation rate of about 65.28%.

Table 2.4 presents the mean, percentiles and standard deviation of our five measures of aspiration and the current levels of the aspiration dimensions. We first recognize that the households' aspirations responses are generally multiples of their current level. On average, the income aspiration of households is $436.62, which is 4.2 times their current income level. In a similar vein, households aspire to gain assets of approximately $8,588.26, which is 5.2 times their current level of assets. The livestock aspiration of households in terms of TLU is 61.34, while the aspired-to herd size is approximately 510 (both about 20 times the current level). Social status aspiration has a mean level of 9 and ranges between 4 and 10. While most household heads have little or no formal education, their aspired-to educational level for their children is high. Among households with children of less than 10 years of age, irrespective of whether the child is currently enrolled in any formal education or not, the mean aspired-to education for both boys and girls is 18 years, which is equivalent to obtaining an undergraduate degree.

Some significant positive correlations between the different aspiration dimensions exist (see Table 2.5), but the magnitudes are rather small. This justifies our use of an aspiration index.

Table 2.4 Summary statistics of aspiration dimensions

Variable	**Mean**	**SD**	**10th percentile**	**90th percentile**
Income aspiration ($)	436.62	584.29	96	960
Asset aspiration ($)	8,588.26	59,715.70	456	9,600
Livestock aspiration (TLU)	61.34	613.19	4.5	50
Livestock aspiration (flock size)	511	6131	35	270

Social status aspiration	9.00	1.11	8	10
Educational aspiration for boys	18.10	2.45	17	23
Educational aspiration for girls	18.12	2.18	17	23
Household Income($)	104.52	127.97	19.20	216
Asset ownership ($)	1,646.70	10,129.32	76.57	2,380.56
Livestock ownership (TLU)	3.18	5.07	0	7.85
Flock size (number)	24.74	35.16	0	57
Social status	5.78	2.02	3	8

Source: Author's calculation from field survey, 2019. Income and income aspiration are reported on a per month basis

Table 2.5 Pairwise correlations between aspiration measures

	Income	Assets	Status	Livestock	Male education	Female education
Income	1.00					
Assets	0.35***	1.00				
Status	0.15***	0.04	1.00			
Livestock	0.01	0.01	0.10***	1.00		
Male education	0.11**	0.14***	0.07*	0.13***	1.00	
Female education	0.15***	0.14***	0.05	0.12***	0.76***	1.00

Notes ***p below 0.01, ***p below 0.05, *p below 0.1. Author's computation from field survey, 2019

2.5.2 Estimation results

We use ordinary least squares (OLS) estimations to explore the relationship between ecological shocks and rural aspirations. Tables 2.6 and 2.7 below present the effects of ecological shocks on the income, asset, livestock, education, social status and aspiration index of the households. We begin by evaluating the effect of ecological shocks on the aspirations index. As can be seen in Table 6, *Prosopis* infestation has a negative impact on the

aspiration index. This result echoes the finding of Kosec and Mo (2017) who found the incidence of floods to have a negative effect on the aspirations of households in Pakistan. *Prosopis* is a direct threat to livelihoods as most households keep livestock. *Prosopis* can reduce pasture land since it forms huge thickets making it hard for the livestock to access common water and feeding points. In the face of this threat, households may become fatalistic and aspire to lesser goals. Furthermore, related to the above and in the light of Kosec and Mo (2017), these shocks may directly impact the welfare and well-being of households. Households may only visualize a bleak future in the face of these ecological shocks, as foreshadowed by their current investment losses. These effects may even be reinforcing, inducing households to lower their aspirations even more when the shocks have past. In line with this result, Jensen (2000) earlier highlighted that households who previously experienced an adverse weather shock depicted lower investments in the education and health of their children.

Table 2.6 Effect of ecological shocks on aspiration index, income aspiration, and asset aspiration

	Aspiration index	**Income aspirations**	**Asset aspirations**
Prosopis infestation	-4.339***	-0.429***	-0.458***
(Yes=1)	(1.635)	(0.109)	(0.147)
Parthenium infestation	-0.734	0.056	-0.001
(Yes=1)	(1.230)	(0.079)	(0.119)
FAW infestation	-0.308	-0.129	-0.048
(Yes=1)	(1.795)	(0.114)	(0.180)
Constant	-21.277***	8.871***	10.848***
	(4.759)	(0.318)	(0.317)
F-statistic	5.11***	16.46***	15.73***
R squared	0.186	0.333	0.311
Other controls	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes
Number of observations	530	530	530

Notes: Robust standard errors are in parentheses. Other controls include knowledge of FAW, age of the household head, education level of the household head, household size, access to credit, extension contact, area of cultivation, livestock ownership, radio ownership, and mobile phone ownership. ***p below 0.01, **p below 0.05, *p below 0.1. Full results are presented in the appendix.

Looking separately into the five dimensions of aspiration, we find *Prosopis* infestation to have a negative and significant relationship with income and asset aspirations (Tables 2.6 and 2.7). As our income and asset outcomes are log-transformed, households that suffer the threat of *Prosopis* infestation have income and asset aspirations lower than households with no *Prosopis* infestation by 42.9 percent and 45.8 percent respectively. As the spread of *Prosopis* can decimate household assets, these results are as expected. Aspiring for many livestock in the future may seem lofty in the face of *Prosopis* with its harmful effects on livestock, leading to bad quality meat which has market consequences and overall income implications.

Table 2.7 Effect of ecological shocks on livestock, status, and educational aspirations

	Livestock aspiration	**Status aspiration**	**Educational aspirations**	
			Boys	**Girls**
Prosopis infestation	-0.188	-6.552	-0.393	-0.223
(Yes=1)	(0.156)	(16.477)	(0.320)	(0.393)
Parthenium infestation	0.157	99.567	0.190	0.165
(Yes=1)	(0.104)	(71.088)	(0.221)	(0.217)
FAW infestation (Yes=1)	0.149	45.966	0.127	0.201
	(0.164)	(37.775)	(0.273)	(0.284)
Constant	8.395***	-225.22	15.251*	14.938*
	(0.392)	(231.32)	(1.003)	(1.218)
F-statistic	2.30***	16.46***	3.54***	3.25***
R squared	0.065	0.049	0.116	0.093
Other controls	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
Number of observations	530	530	530	530

Notes: Robust standard errors are in parentheses. Other controls include knowledge of FAW, age of the household head, education level of the household head, household size, access to credit, extension contact, area of cultivation, livestock ownership, radio ownership, and mobile phone ownership. ***p below 0.01, **p below 0.05, *p below 0.1. Full results are presented in the appendix.

The fact that *Prosopis* has been around for a long time may mean that households perceive it less as a 'shock' and more as a permanent decrease in productivity – which might be why it is having a stronger effect on aspirations. The other shocks also appear to have a negative effect on the index as well as income and asset aspirations but the results are not significant.

2.5.3 Mechanism

We follow the conceptual framework we developed in section 2 to explore the possible mechanism linking ecological shocks and aspirations. We empirically test this framework using the households' current income and asset status as the mediating factors between ecological shocks and aspirations. To do this, we regress income and assets on the ecological stressors and shock along with other model variables. The results, presented in Table 2.8, show a negative association between ecological shocks and the current income and asset levels of households. Ecological stressors and shocks may in fact have caused a reduction in household income, as expected. While income was reduced by about 31%, assets have been reduced by 38%. The results thus confirm that the current wealth status of households may just be a pathway between ecological shocks and aspirations.

Previous empirical analysis has found that the current income and asset level of households matter in the formation of aspirations. This insight goes back to the concept of 'capacity to aspire' (Appadurai, 2004), where low-income households usually aspire to lesser goals owing to their present conditions, which make them fatalistic. Similar insights have been reported by Stutzer (2004), Janzen et al. (2017), Knight and Gunatilaka (2012), and Kosec and Mo (2017) in their various attempts to understand aspiration formation.

Table 2.8 Ecological shocks on Income and assets

	Income	**Assets**
Prosopis infestation (Yes=1)	-0.311***	-0.385***
	(0.113)	(0.152)
Parthenium infestation (Yes=1)	0.042	-0.090
	(0.134)	(0.149)
FAW infestation (Yes=1)	-0.089	-0.014
	(0.151)	(0.150)
Constant	7.001***	7.279***
	(0.451)	(0.616)
F-statistic	16.50***	12.75***
R squared	0.312	0.382
Other controls	Yes	Yes
Village fixed effects	Yes	Yes
Number of observations	530	530

Notes: Robust standard errors are in parentheses. Other controls include knowledge of FAW, age of the household head, education level of the household head, household size, access to credit, extension contact, area of cultivation, livestock ownership, radio ownership, and mobile phone ownership. ***p below 0.01, **p below 0.05, *p below 0.1. Full results are presented in the appendix.

We further test the relationship between the current income and asset levels of households and the aspirations index. As our sample primarily consists of smallholder farmers who live close to or below the poverty line, our findings here reflect some parts of the behavioural poverty trap (Haushofer and Fehr, 2014) which alludes to the empirical evidence presented above. Simply put, poverty can affect behavioural outcomes such as aspirations which can further affect future-oriented outcomes which have implications for one's poverty. From the results in Table 2.9, income and asset holdings of households are positively associated with the aspiration index. This finding, although largely suggestive, further confirms the endowment-increasing effects on aspirations. That said, it should be noted that other mechanisms may exist, but due to limited data, we only tested the income mechanism.

Table 2.9 Income/asset and aspiration index

	Aspiration index
Income	2.050***
	(0.530)
Asset	0.295***
	(0.395)
Constant	-21.277***
	(4.759)
F-statistic	9.35***
R squared	0.136
Other controls	Yes
Village fixed effects	Yes
Number of observations	530

Notes: Robust standard errors are in parentheses. Other controls include the age of the household head, education level of the household head, household size, access to credit, extension contact, area of cultivation, livestock ownership, radio ownership, and mobile phone ownership. ***p below 0.01, **p below 0.05, *p below 0.1.

2.5.4 Robustness check

We perform a robustness check to confirm the findings of the study. We employ an instrumental variable (IV) approach to control for the potential endogeneity of *Prosopis*. While *Parthenium* and FAW are recent ecological shocks in the study area, one could argue that the case of *Prosopis* may be different, especially as it was introduced in the area. Thus, one might be concerned that *Prosopis* intensity is less likely to be randomly distributed, and more likely to be correlated with aspirations through unobservables. An appropriate instrument should determine *Prosopis* infestation but have no direct effect on the outcome variables (aspirations). As the growth and spread of *Prosopis* depend on the soil condition, we exploit the soil type where *Prosopis* infestation is observed as the instrument. *Prosopis* thrives on almost all soils except rocky ones. It survives by extending its trunk very deep to obtain water, which is seemingly impossible in rocky soils. Our data

show us a positive and highly significant correlation between soil type and *Prosopis* infestation (Table A6). We argue that our instrument influences aspirations only through its effect on *Prosopis* infestation and maintain instrument admissibility. We also performed some correlation analysis to further confirm the admissibility of the instrument (appendix Table A7).

Table 2.10 Effect of ecological shocks on aspiration index, income aspiration, and asset aspiration

	Aspiration index	**Income aspirations**	**Asset aspirations**
Prosopis infestation	-9.772***	-0.448***	-1.010***
(Yes=1)	(4.360)	(0.351)	(0.326)
Parthenium infestation	-0.761	0.056	0.020
(Yes=1)	(1.224)	(0.078)	(0.106)
FAW infestation (Yes=1)	-0.581	-0.130	-0.086
	(1.648)	(0.105)	(0.143)
Constant	-19.142**	8.879***	9.183***
	(4.933)	(0.331	(0.429)
F-statistic	4.69***	26.56***	8.39***
Other controls	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes
Number of observations	530	530	530

Notes: Robust standard errors are in parentheses. Other controls include knowledge of FAW, age of the household head, education level of the household head, household size, access to credit, extension contact, area of cultivation, livestock ownership, radio ownership, and mobile phone ownership. ***p below 0.01, **p below 0.05, *p below 0.1. Full results are presented in the appendix.

Table 2.11 Effect of ecological shocks on livestock, status, and educational aspirations

	Livestock aspirations	**Status aspirations**	**Educational aspirations**	
			Boys	**Girls**
Prosopis infestation (Yes=1)	-50.711	-0.420	-1.021	-0.139
	(147.546)	(0.395)	(1.103)	(1.026)

Parthenium infestation (Yes=1)	99.380	0.156	0.187	0.166
	(60.870)	(0.109)	(0.234)	(0.240)
FAW infestation (Yes=1)	43.940	0.138	0.098	0.205
	(81.490)	(0.147)	(0.316)	(0.324)
Constant	-207.122	8.489***	15.505***	14.904***
	(239.536)	(0.447)	(0.995)	(1.008)
F-statistic	8.65***	20.36***	6.32***	7.26
Other controls	Yes	Yes	Yes	Yes
Village fixed effects	Yes	Yes	Yes	Yes
Number of observations	530	530	530	530

Notes: Robust standard errors are in parentheses. Other controls include knowledge of FAW, age of the household head, education level of the household head, household size, access to credit, extension contact, area of cultivation, livestock ownership, radio ownership, and mobile phone ownership. ***p below 0.01, **p below 0.05, *p below 0.1. Full results are presented in the appendix

The results of the IV regressions as shown in Tables 2.10 and 2.11 confirm the findings from the OLS model. When aggregating the reported aspiration dimension into an index, *Prosopis* invasion exhibits a negative relationship with this index. For the individual dimensions, negative significant associations are also observed for both income and asset aspirations. This is also the case with the other dimensions, though the negative associations are not statistically significant. Summarily, the IV regressions also confirm the negative relationship between ecological shocks and aspirations.

2.6 Conclusion

In this article, we sought to understand how households form their aspirations under ecological stressors and shock measured by the incidence of *Prosopis*, *Parthenium*, and FAW. We used five rural aspiration dimensions: income, asset, livestock, status and education as well as an aspiration index to capture the overall aspiration feeling of households. We employ primary data from 530 households in the Marigat division of Kenya. Exploring the household survey data reveals the existence of significant differences between households that are affected by ecological shocks and

households that are not. These significant differences spread across a range of farm and household characteristics.

Employing regression approaches to identify the effect of ecological shocks on aspirations, we establish a negative relationship between ecological shocks and aspirations. Furthermore, different ecological shocks have varying effects on the different dimensions of aspirations. Households that face a *Prosopis* infestation have lower income, assets and livestock aspirations than households without infestation. This could be attributed to the negative effects of these stressors and shocks on the income status of households given that most households are smallholder farmers. This study offers empirical support to the theoretical concept of 'capacity to aspire' based on the tested mechanism.

Understanding how best to facilitate resilience to ecological stresses and shocks requires an understanding of how these shocks affect attitudes and behaviour. To the extent that current income and asset levels affect aspirations, poverty reduction strategies such as social safety nets and cash transfer interventions should be encouraged. Our results are suggestive that poorer households, when faced with an ecological shock, may be driven to a downward aspirational spiral, landing them into a poverty trap. While it is beyond the scope of this study to establish how such relief social protection programs attenuate constraints to the formation of aspirations, we believe that a well-targeted program that seeks to increase the income of rural households will in a way increase their aspirations for the future.

Two limitations of this study could be taken up in future research. Firstly, despite dealing with endogeneity by specifying IV regressions, we cannot claim to have fully identified causal impacts given the cross-sectional nature

of the data, making it hard to address all potential biases. The use of experimental approaches or panel data may offer better causal identification and should be explored. Moreover, as aspirations evolve over time, panel data offer additional advantages by controlling for unobserved heterogeneities. Secondly, we used five aspiration dimensions that pertain to most rural livelihoods. However, aspirations span many more dimensions, such as health, security, and nutrition. Future research in this direction may want to address other dimensions of rural aspirations. That notwithstanding, this analysis is one of the first to quantify aspirations and establish the links between ecological shocks and aspiration based on five aspiration dimensions. As context matters, follow-up research is warranted to test these empirical findings and add to the literature on aspiration formation in rural communities.

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2.8 Appendix

Table A1 Effect of ecological shocks on aspiration index, income aspiration, and asset aspiration (full results)

	Aspiration index	**Income aspirations**	**Asset aspirations**
Prosopis infestation	-4.339***	-0.429***	0.458***
	(1.635)	(0.109)	(0.147)
Parthenium	-0.734	0.056	-0.001
infestation	(1.230)	(0.079)	(0.119)
FAW infestation	-0.308	-0.129	-0.048
	(1.795)	(0.114)	(0.180)
FAW knowledge	-5.835**	-0.183	0.124
	(2.851)	(0.203)	(0.228)
Age of the household	-0.061	-0.005	-0.004
head	(0.051)	(0.003)	(0.004)
Education of the	0.440***	0.056***	0.061***
household head	(0.172)	(0.009)	(0.013)
Household size	-0.047	-0.003	0.075***
	(0.215)	(0.013)	(0.021)
Access to credit	1.298	0.009	0.301***
	(1.178)	(0.072)	(0.107)
Extension contact	0.961	0.135	0.155
	(1.308)	(0.084)	(0.121)
Area of cultivation	0.874	0.026	0.026
	(0.537)	(0.024)	(0.033)
Livestock ownership	0.358***	0.020***	0.064***
	(0.142)	(0.007)	(0.009)
Radio ownership	0.763	0.020	0.170
	(1.320)	(0.074)	(0.118)
Mobile phone	1.709	0.074	0.126
ownership	(1.437)	(0.115)	(0.143)
Constant	-21.277***	8.871***	10.848***
	(4.759)	(0.318)	(0.317)
F-statistic	5.11***	16.46***	15.73***

R squared	0.186	0.333	0.311
Village fixed effects	Yes	Yes	Yes
Number of observations	530	530	530

Notes:***p below 0.01, **p below 0.05, *p below 0.1. standard errors are in parentheses.

Table A2 Effect of ecological shocks on livestock, status, and educational aspirations (full results)

	Livestock aspirations	**Status aspirations**	**Educational aspirations**	
			Boys	**Girls**
Prosopis	-0.188	-6.552	-0.393	-0.223
infestation	(0.156)	(16.477)	(0.320)	(0.393)
Parthenium	0.157	99.567	0.190	0.165
infestation	(0.104)	(71.088)	(0.221)	(0.217)
FAW infestation	0.149	45.966	0.127	0.201
	(0.164)	(37.775)	(0.273)	(0.284)
FAW knowledge	-0.173	-7.366	-0.531	-0.418
	(0.262)	(29.632)	(0.624)	(0.573)
Age of the	0.009	2.173	-0.002	0.008
household head	(0.042)	(2.967)	(0.008)	(0.012)
Education of the	0.003	0.905	0.069**	0.118***
household head	(0.013)	(5.888)	(0.030)	(0.045)
Household size	0.040**	1.911	-0.043	-0.031
	(0.017)	(8.210)	(0.039)	(0.038)
Access to credit	0.070	-111.220	0.296	0.231
	(0.104)	(76.725)	(0.221)	(0.238)
Extension contact	0.108	-85.704	0.253	-0.080
	(0.107)	(61.902)	(0.242)	(0.263)
Area of	-0.034	-16.504	0.034	-0.027
cultivation	(0.024)	(12.669)	(0.079)	(0.054)
Livestock	0.016*	9.678	0.008	0.017
ownership	(0.009)	(11.961)	(0.019)	(0.020)
Radio ownership	0.130	69.187	0.045	-0.158

	(0.109)	(62.426)	(0.258)	(0.265)
Mobile phone ownership	0.004	17.485	0.598*	0.133
	(0.148)	(19.023)	(0.351)	(0.325)
Constant	8.395***	-225.22	15.251***	14.938***
	(0.392)	(231.32)	(1.003)	(1.218)
F-statistic	2.30***	16.46***	3.54***	3.25***
R squared	0.065	0.049	0.116	0.093
Village fixed effects	Yes	Yes	Yes	Yes
Number of observations	530	530	530	530

Notes:***p below 0.01, **p below 0.05, *p below 0.1. standard errors are in parentheses.

Table A3 Effect of ecological shocks on income and asset (full results)

	Income	**Assets**
Prosopis infestation	-0.311***	-0.385***
	(0.113)	(0.152)
Parthenium infestation	0.042	-0.090
	(0.134)	(0.149)
FAW infestation	0.089	0.014
	(0.151)	(0.150)
FAW knowledge	0.709*	0.714
	(0.419)	(0.557)
Age of the household head	-0.002	-0.001
	(0.004)	(0.005)
Education of the household head	0.064***	0.064***
	(0.009)	(0.015)
Household size	0.013	0.094***
	(0.016)	(0.024)
Access to credit	0.143**	0.173
	(0.081)	(0.129)
Extension contact	-0.074	0.100
	(0.105)	(0.143)
Area of cultivation	0.019	-0.003

	(0.020)	(0.039)
Livestock ownership	0.050***	0.085***
	(0.007)	(0.021)
Radio ownership	0.229**	0.499***
	(0.100)	(0.136)
Mobile phone ownership	0.345**	0.646***
	(0.173)	(0.225)
Constant	7.001***	7.279***
	(0.451)	(0.616)
F-statistic	16.50***	12.75***
R squared	0.312	0.382
Village fixed effects	Yes	Yes
Number of observations	530	530

Notes:***p below 0.01, **p below 0.05, *p below 0.1. standard errors are in parentheses.

Table A4 Effect of ecological shocks on aspiration index, income aspiration, and asset aspiration (full estimates of IV regression)

	Aspiration index	**Income aspirations**	**Asset aspirations**
Prosopis infestation	-9.772***	-0.448***	-1.010***
	(4.360)	(0.351)	(0.326)
Parthenium infestation	-0.761	0.056	0.020
	(1.224)	(0.078)	(0.106)
FAW infestation	-0.581	-0.130	-0.086
	(1.648)	(0.105)	(0.143)
FAW knowledge	-5.915**	-0.183	-0.070
	(3.028)	(0.194)	(0.263)
Age of the household	-0.060	-0.004*	-0.004
head	(0.046)	(0.003)	(0.004)
Education of the	0.446***	0.054***	0.044***
household head	(0.149)	(0.009)	(0.013)
Household size	-0.061	-0.003	0.048***
	(0.211)	(0.013)	(0.018)

Access to credit	1.163	0.008	0.246**
	(1.157)	(0.074)	(0.102)
Extension contact	0.893	0.134*	0.119
	(1.271)	(0.081)	(0.111)
Area of cultivation	0.867**	0.026	0.025
	(0.344)	(0.022)	(0.030)
Livestock ownership	0.350***	0.020***	0.040***
	(0.122)	(0.007)	(0.010)
Radio ownership	0.829	0.021	0.047
	(1.224)	(0.078)	(0.106)
Mobile phone	1.722	0.075	-0.048
ownership	(1.532)	(0.098)	(0.133)
Constant	-19.142***	8.879***	9.183***
	(4.933)	(0.331	(0.429)
F-statistic	4.69***	26.56***	8.39***
Village fixed effects	Yes	Yes	Yes
Number of observations	530	530	530

Notes:***p below 0.01, **p below 0.05, *p below 0.1. standard errors are in parentheses.

Table A5 Effect of ecological shocks on livestock, status, and educational aspirations (full estimates of IV regression)

	Livestock aspirations	**Status aspirations**	**Educational aspirations**	
			Boys	**Girls**
Prosopis infestation	-50.711	-0.420	-1.021	-0.139
	(147.546)	(0.395)	(1.103)	(1.026)
Parthenium	99.380	0.156	0.187	0.166
infestation	(60.870)	(0.109)	(0.234)	(0.240)
FAW infestation	43.940	0.138	0.098	0.205
	(81.490)	(0.147)	(0.316)	(0.324)
FAW knowledge	-7.577	-0.174	-0.535	-0.417
	(150.686)	(0.271)	(0.579)	(0.595)
Age of the household	2.177	0.009	-0.002	0.008
head	(2.289)	(0.041)	(0.008)	(0.009)

Education of the	0.931	0.003	0.069*	0.118***
household head	(7.429)	(0.013)	(0.028)	(0.029)
Household size	1.783	0.039**	-0.044	-0.030
	(10.522)	(0.019)	(0.040)	(0.041)
Access to credit	-112.234**	0.064	0.281	0.234
	(57.385)	(0.103)	(0.222)	(0.227)
Extension contact	-86.212	0.105	0.246	-0.079
	(63.154)	(0.114)	(0.243)	(0.249)
Area of cultivation	-16.599	-0.035	0.033	-0.027
	(17.126)	(0.030)	(0.065)	(0.067)
Livestock ownership	9.629	0.016	0.007	0.017
	(6.081)	(0.010)	(0.023)	(0.024)
Radio ownership	69.716	0.133	0.053	-0.159
	(60.911)	(0.109)	(0.234)	(0.240)
Mobile phone	17.572	0.004	0.599	0.132
ownership	(76.262)	(0.137)	(0.293)	(0.301)
Constant	-207.122	8.489***	15.505***	14.904***
	(239.536)	(0.447)	(0.995)	(1.008)
F-statistic	8.65***	20.36***	6.32***	7.26
Village fixed effects	Yes	Yes	Yes	Yes
Number of observations	530	530	530	530

Notes:***p below 0.01, **p below 0.05, *p below 0.1. standard errors are in parentheses.

Table A6 Correlation between *Prosopis* infestation and soil type

	Prosopis infestation	**Soil type**
Prosopis infestation	1.0000	
Soil type	0.2543***	1.0000

Notes:***p below 0.01, **p below 0.05, *p below 0.1

Table A7 Regression coefficient of soil type in outcome equations

	Coefficient of soil type
Aspiration index	0.563
	(0.497)
Income aspiration	-0.004
	(0.031)
Asset aspiration	-0.022
	(0.048
Livestock aspirations	-7.373
	(7.212)
Status aspiration	-0.026
	(0.079)
Educational aspiration	-0.048
	(0.098)

Notes:***p below 0.01, **p below 0.05, *p below 0.1

Chapter 3

How Does Collective Action Affect Aspirations of Smallholder Households?[7]

Abstract

While it is increasingly recognized that aspirations drive economic behaviour and outcomes, it is not clear how aspirations are formed. Theoretical literature assumes that aspirations are formed in the 'thick of life' and by observing neighbours and peers in a cognitive neighbourhood. Thus, individuals with a small number of interactions within a homogeneous group may have more constrained aspirations than someone who interacts with a wider, more diverse group. We test this theoretical relationship between group membership and individual aspirations in the context of cooperative membership. Specifically, we examine whether cooperative membership is associated with the formation of income and asset aspirations

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Author contributions: Tabe-Ojong, MP Jr.: conceptualization, data collection and curation, formal analysis, writing original draft; Heckelei, T: conceptualization, funding acquisition, writing - review and editing the paper; Baylis, K: writing - review and editing the paper; Sebastian, R: writing - review and editing the paper.

of smallholder farmers. We employ two spatially motivated instruments for cooperative membership using household-level data from smallholder farmers in Kenya. We find cooperative membership to be associated with an increase by 0.38-standard deviations in income aspirations and an increase by 0.46-standard deviations in asset aspirations. These results are not only robust to multiple controls for selection into cooperative membership but also to the use of doubly robust estimators. Using mediation analysis to understand the mechanism driving this relationship, we find support for the hypothesis that exposure to role models explain the increase in aspirations associated with cooperative membership. Given the growing evidence regarding the relevance of aspirations in achieving poverty reduction, food security and women's empowerment, our study supports the notion that interventions and programmes that widen the aspiration window of individuals are an important conduit to strengthen aspirations.

Keywords: aspirations; cooperative membership; capacity to aspire, role models; Kenya

JEL classification codes: C36, D31, D90, D91, P13

3.1 Introduction

The fact that poor households forego investments with high returns has so far been attributed to external constraints like asymmetric information, to imperfect and thin markets as well as to the lack of well-functioning credit and insurance markets (Janzen et al., 2017; Banerjee and Newman, 1993; Galor and Zeira, 1993; Dasgupta and Ray, 1986). This lack of investment usually keeps them trapped in self-reinforcing mechanisms, which perpetuate their poverty status (La Ferrara, 2019). While these external constraints offer insights into this puzzling behaviour among poor households, they only provide incomplete or at best unsatisfying explanations for a lack of future-oriented behaviour (Janzen et al., 2017).

Recent economic research suggests an additional explanation for the lack of investment: low aspirations (Macours and Vakis, 2014; Duflo, 2013; Ray, 2006; Appadurai, 2004;). Aspirations are defined as goals towards which individuals invest time, money and effort (Bernard and Taffesse, 2014). They are future-oriented and exclude present-level gratification. Their first appearance in economics goes back as far as the work of Herbert Simon (Simon, 1956) who posited that aspirations serve as intermediate goals, but they recaptured attention with Appadurai's work on a 'capacity to aspire' (Appadurai, 2004). While a burgeoning theoretical and empirical literature has established the link between aspirations and future-oriented outcomes (Bloem, 2021; Ross, 2019; Kosec et al., 2018; Janzen et al., 2017; Besley, 2016; Dalton et al., 2016; Pasquier-Doumer and Brandon, 2015), less research is geared toward understanding how aspirations are formed (or eroded). Based on Appadurai (2004) and with insights from the theoretical aspiration models on aspiration formation (Dalton et al., 2016; Genicot and Ray, 2017, 2020), it is clear that aspirations are socially determined.

This paper empirically explores the formation of aspirations following the aspiration window concept of Ray (2006). We use primary data from a cross-sectional survey of 530 smallholder farm households to investigate how cooperative membership affects the formation of income and asset aspirations of smallholder farmers. We further explore the mechanism through which cooperative membership may increase income and asset aspirations. Here, we find suggestive evidence that exposure to role models in these cooperative groups may be the underlying mechanism. Our contributions lie in providing new insights into the understanding of aspiration formation, specifically income and asset aspirations, which have a direct link to household welfare and poverty. More precisely, we provide additional evidence of how the expansion of collective action by smallholder farmers may help build aspirations.

To our knowledge, only Mojo et al. (2016) have so far examined the direct role of cooperative membership and the related collective action in shaping the aspirations of smallholder farmers. Using matching estimators (propensity score matching) to control for observable characteristics, they find that cooperative membership is crucial in improving the overall aspirations of smallholders in Ethiopia when considered as an index. However, they report no statistically significant association effect of cooperative membership on the various dimensions of the index like income, assets, status and the environment except for education aspirations. In a closely related analysis, Garcia et al. (2020) examine how a group lending scheme strengthens aspirational hope and welfare in Sierra Leone. Exploiting the BRAC's microcredit program, they find microcredit participation to have a positive association with both aspirational hope and economic welfare, with aspirational hope being a mediator for microcredit access and welfare.

One challenge in this literature is the endogeneity of cooperative participation. We instrument for household membership decisions using the village-level membership rate and the number of cooperative members around every sampled household using 3 distance buffers of 1, 2 and 5km. We use the 1km buffer, testing robustness with the 2km and 5km buffers. Our IV regressions with the use of the different instruments all point to a positive relationship between cooperative membership and income and asset aspirations. To further test our findings, we also utilize selection on observables estimators like the inverse probability weights and the doubly robust estimators (Inverse Probability Weighted Regression Adjustment and Augmented Inverse Probability Weighting). The core results are highly robust across these different specifications. We further find that role models act as an important mediator between cooperative membership and aspirations.

The next section outlines how aspirations are formed in more detail, their link to cooperative membership, and factors explaining membership. Section 3.3 presents the empirical strategy and the model, while data, variable measurement and some summary statistics are presented in section 3.4. The empirical results are discussed in section 3.5. The chapter ends with a conclusion and policy implications.

3.2 Aspiration Formation and cooperative membership

Aspirations are motivational goals that emerge from human interactions in a social setting (Appadurai, 2004) and are thus born in the ‘thick of life’. Despite their endogenous formation within a social system, they are not uniform across the community due to differences in what Appadurai terms a ‘capacity to aspire’ (Appadurai, 2004) and due to an individual’s internal,

psychological constraints (Dalton et al., 2016). Aspirations are constrained by an individual's aspiration window, which is defined as a cognitive zone of similar or attainable individuals from which s/he draws her aspirations. Appadurai (2004) postulates in his foundational work that the poor are restricted in formulating appropriate aspirations due to the less frequent presence of successful peers within their cognitive reach. The better-off easily navigate along relational pathways and exchange information more routinely among themselves. They possess what Ray (2006) terms a wider aspiration window.

An individual's aspiration window is formed from the cognitive realm of observable individuals with similar traits with whom they can identify (Bernard et al., 2014); a personal social network of peers and its context. The empirical literature on aspiration formation relates to the concept of role models, whose appearance in the aspiration window drives aspiration formation in a major way (Bernard et al., 2019; Macours and Vakis, 2014; Riley, 2018). Consequently, social determinants that widen a person's aspiration window are hypothesized to foster the formation of aspirations by increasing the likelihood of encountering role models (La Ferrara, 2019).

Based on social learning and information flow under the aspiration window, Ray (2006) suggests that improving aspirations depends on collective action or group membership. He identifies three ways through which this can happen. Firstly, groups serve as information hubs where information can be easily passed on to members. Groups can serve as repositories of information garnered from numerous sources and internally conveyed to members. Moreover, members can easily observe and build their information base by observing and learning from the experiences of other members of their group. Members share practical experiences amongst

themselves, which is otherwise hard to do merely via compelling word of mouth. For instance, telling a poor neighbour about the positive returns from livestock savings may make little sense if this is not complemented by accounts of more practical experience.

Secondly, groups can more easily and reliably communicate with the general public and advocate concerns, as compared to single individuals. Their numerical strength signals increased trust and credibility, which makes them more relevant as external conveyors of information. Finally, groups can act as coordination devices in the light of a multiple-equilibrium scenario. This succinctly summarizes a feature of group effectiveness. "A state x persists in society, which leads individuals in that society to take actions a. The actions a aggregate back to x, and the cycle is complete." (Ray, 2006, pp 8). A household that finds itself among others who do not invest may find it comfortable also not to invest. However, if everyone else was doing so and you were not, it would rather motivate you to behaviourally align with the others and invest. A cooperative group can thus be seen as a coordinating device to break this low-investment scenario.

Another way of looking at group membership is from a social-exposure perspective. In relaxing external constraints faced by households based on group membership, households are also exposed to reference leaders and role models, further increasing their aspirations. Social exposure further improves on information flow, which affords individuals the opportunity to more fully engage in a diverse set of investment options to meet stated goals. Also, social exposure triggers social interaction, which increases the navigational capacity of individuals necessary for the formation of aspirations.

Macour and Vakis (2014) explore this hypothesis in their investigation on the social interaction effect on aspiration formation in Nicaragua. They randomly assign households to three treatment groups receiving different packages of a conditional transfer payment. Female leaders, functioning as successful role models, were randomly allocated to one of the interventions. They find members in groups with successful and motivated leaders to have higher aspirations and exhibit positive future-oriented behaviour. They show an increased probability of higher incomes and investment in the education and nutrition of their children. In a different experiment, Bernard et al. (2019) present short documentaries of successful individuals and find heightened aspirations and investments in the treatment groups. From the theoretical discussion and the empirical evidence above, exposure to role models seems to be a pathway to improve aspirations. In this regard, we argue that group membership is one way to improve social interaction and to expose individuals to role models (e.g. reference farmers, village leaders and other members they look up to) who may serve as a reference for individuals to build their aspirations.

Cooperative groups are abundant in rural SSA and can promote improved access to inputs, agricultural marketing and savings. As a forum for organized social interaction, they may also affect aspirations (Mojo et al., 2016). Along with increasing the probability of encountering successful peers, they can integrate information from a variety of sources and channel this knowledge to their members (Mojo et al., 2016). Due to the credibility of cooperatives, and their size, they can also link their members to external stakeholders, thus further widening the aspirational window.

Assuming sufficient heterogeneity among members, we expect membership in cooperatives to generally increase aspirations and specifically explore the

effect of membership on income and asset aspiration. In these groups, individuals meet and exchange on a variety of issues with the ultimate goal of improving their income levels and their livelihoods. Moreover, such groups may be an arena where individuals are exposed to role models, which we see as the mediating channel for the hypothesized positive association between cooperative membership and income and asset aspirations. Results might be indicative of potential future policies putting more emphasis on non-market measures to reduce rural poverty by supporting existing community groups. Next to group membership, other factors potentially explain the size of an aspiration window as well. Potential factors are education and age (Ganguli, 1957; Hyll and Schneider, 2013), life satisfaction (Mason and Faulkenberry, 1978), income and asset levels (Knight and Gunatilaka, 2012; Stutzer, 2004) and psychological factors like locus of control (Flowers et al., 2003).

3.3 Empirical analysis

We estimate aspirations as a function of cooperative membership and other household characteristics:

$$Y_i = \beta \boldsymbol{X_i} + \gamma M_i + \varepsilon_i \quad (1)$$

where Y_i represents the income or asset aspirations of households; $\boldsymbol{X_i}$ is a vector of explanatory variables. The variable M_i is an indicator for cooperative membership; β and γ are the parameters and ε_i is the error term. Estimates of the parameter γ give the effect of cooperative membership on income and asset aspirations. Based on our hypothesis, a positive coefficient for γ indicates a positive association between cooperative membership and aspirations.

Relating to the conceptual considerations in section 2, $\boldsymbol{X_i}$ includes controls like age of household head, education, life satisfaction and locus of control. In addition, we follow Simon's (1956) concept of discretely progressing aspiration levels, which postulates that each ceiling (aspired state) is a later floor (achieved state), and thus include the current state in terms of current income and assets as absolute values – consistent with aspiration measures – in our calculations. They are the reference, or the floor, that aspirations relate to. Current asset levels are disaggregated into durables, livestock, and farm size.

Our variable of interest may be endogenous due to self-selection into cooperative membership, potentially biasing our estimate of the effect of cooperative membership on aspirations. To control for this, we use an instrumental variable approach. We use two closely related instruments: the village cooperative membership rate, and the number of cooperative members around sampled households in different distances. The first instrument is computed by counting all cooperative members in a village excluding the farmer of interest, and dividing them by the total number of households in the village. This instrument essentially captures the supply of cooperatives, i.e. whether households can easily access cooperatives. Given that it is constructed at a higher spatial scale with the exclusion of the concerned, we expect any effect to only flow through the cooperative membership pathway. Said differently, our instrument is unlikely to influence an individual's aspirations except through cooperative membership.

For the second instrument, we employ a distance-based measure related to the village membership rate: the number of cooperative members around a representative household within a circle of a certain radius (maximum

distance to household). We use 3 different radii of 1km, 2km and 5km. For the main models, we used the 1km circle and test for its robustness using the 2km and 5km distances. This second instrument is motivated by the literature on social learning and neighbourhood effects. Households who are closer to cooperative members are more likely to learn about the advantages and benefits of cooperative membership. In Ethiopia for example, Di Falco et al. (2020) found farmers to use specific climate-change adaptation strategies based on the adaptation strategies of their neighbours. Similar insights were obtained by Bandiera and Rasul (2006) in Mozambique, where they found peer effects (family and friends) to drive the adoption of a new crop. We show in the next sections that our instruments are valid, as they not only satisfy the relevance assumption but also the exogeneity condition.

3.4 Data collection and descriptive statistics

This study employs data from a farm-household survey conducted between July and August 2019 in the Marigat division of northern Kenya. Households were selected using a two-stage sampling technique. First, 35 villages, based on their sizes, were randomly selected in all four wards of the division (Marigat, Ilchamus and Mochongoi and Ewalel/Chapchap) using the probability proportional to size technique. This activity was jointly undertaken with the Kenyan National Bureau of Statistics (KNBS). Village household lists were then constructed in all the randomly selected villages with the help of village authorities. From these lists, 15-16 households were randomly selected, giving a total of 530 households who were interviewed by a group of well-trained enumerators.

Interviews were carried out with the household head or spouse in their native language. The survey was designed on the Survey Solutions platform of the World Bank, enabling us to check the quality of the data on a real-time basis. As part of the training of the enumerators, the survey was also pretested to enable the enumerators to master the questions and framing, especially regarding aspirations. The survey contains detailed information on the aspiration levels of households based on 5 dimensions (assets, livestock, income, education, and social status), socio-demographic characteristics (education, age, household size), asset and livestock holdings, income, and membership in cooperative associations, as well as information on institutional services like credit access and extension services.

3.4.1 Measurement of key variables

Because of its multidimensional nature, various measurements and scales have been used as proxies for aspirations. While some authors used internal measures thought to influence the future like depression scales (Macours and Vakis, 2009), or locus of control and self-efficacy (Bernard et al., 2011), Knight and Gunatilaka (2012) used a minimum adequate income reported by individuals as a proxy for income aspirations. Beaman et al. (2012) employed the more direct measure of asking parents about the educational level and the chosen occupation they wish their children attain at 25 as well as the aspired village leadership position for their female children. Building on this direct approach, Bernard and Taffesse (2014) put forward a more central and reliable measuring instrument for capturing aspirations. They relied on the self-reporting of aspiration levels based on several dimensions (in their case, asset aspiration, social status aspiration, educational aspiration, and income aspiration). This framework has been

tested by Kosec and Mo (2017) on all four of these dimensions, and by Janzen et al. (2017) who only considered income aspiration and the educational aspiration of children. This study uses this recent aspiration-measuring framework to enable comparison with the scarce extant literature and to gain new insights into what forms rural aspirations. In our case, we make use of the income and asset aspirations of households as outcome variables, as they have a somewhat direct link to household welfare and poverty. We asked two questions here:

- What is your present level of income/asset?

- What level of income/asset would you like to achieve in the future?

While income aspirations relate more to the short-term aspirations of households, asset aspirations are more forward-looking, allowing us to address issues related to the long-term poverty prospects of households. We use the monetary values of asset aspirations of households to enable comparison with income aspirations.

Table 3.1 offers basic descriptive characteristics and definitions of the variables considered in the analysis. Cooperative membership is an indicator variable that takes the value of one for households that are members in cooperatives, and zero otherwise. From the table, household heads have a mean age of 45 years and a mean educational level of 8 years, which is just above primary education.

Households reported an annual income of approximately 1,0887Ksh[8] with an accompanying asset value of 171,532Ksh. Most households own assets ranging from productive assets to information assets, as well as non-productive assets. Being a livestock community, households also own livestock like cows, goats and sheep. Households have a mean income aspiration of approximately 45,484.15Ksh and an asset aspiration of 894,611.3Ksh. In terms of the key-dependent variable, only about 25% of households belong to an agricultural cooperative.

Table 3.1 Descriptive statistics of variables used in the estimation models

	Mean	**SD**
Cooperative membership (1=Yes)	0.25	0.43
Age of head (years)	45.15	15.61
Education of head (years)	7.89	4.86
Life satisfaction (1=Yes)	0.65	0.47
Internal Locus of control	0.79	0.22
External Locus of control	0.67	0.23
Village cooperative membership	0.25	0.21
Number of cooperative members (1km)	3.24	3.16
Number of cooperative members (2km)	5.73	6.31
Number of cooperative members (5km)	21.67	22.14
Income (Ksh)	10,887.65	13,330.24
Asset (Ksh)	171,532.50	1,055,138
Income aspiration (Ksh)	45,484.15	60,869.41
Asset aspiration (Ksh)	89,4611.3	6,220,386

Source: Authors' computation from survey data, 2019

[8] 1Ksh= $0.0096 (06.07.2019)

Table 3.2 Differences in means between cooperative and non-cooperative members

Variable	Cooperative membership	Non-cooperative membership	Mean differences
Age of household head	40.80 (1.11)	46.60 (0.81)	-5.80***
Education level of household head	9.28 (0.39)	7.43 (0.24)	1.85***
Life satisfaction	0.69 (0.04)	0.63 (0.02)	0.06
Internal Locus of control	0.85 (0.02)	0.78 (0.01)	0.07***
External Locus of control	0.69 (0.02)	0.67 (0.01)	0.02
Village cooperative membership rate	0.43 (0.02)	0.19 (0.01)	0.24***
Income	1,5039.1 (1,677.76)	9,496.86 (513.93)	5,542.23***
Asset	392394 (180,190.2)	9,7541.11 (8,080.96)	294,852.9***
Income aspiration	58,060.15 (6495.10)	41,271.03 (2,752.74)	16,789.12***
Asset aspiration	1,337,135 (750,813.7)	746,360.2 (258,893.2)	590,775.1

Notes: Standard deviations are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

To gain initial insights into the observed differences between cooperative members and non-members, a mean difference test is undertaken and the results are presented in Table 3.2. Cooperative members are younger than non-cooperative members and have less experience in crop production and livestock rearing. They are also better educated than non-cooperative members, with larger families as well. Furthermore, cooperative members have a higher internal locus of control than non-cooperative members.

Cooperative members also have higher income aspirations than non-cooperative members, but asset aspirations are not statistically different between the two groups. Cooperative members and non-members have different current levels of income and assets. The substantial differences between cooperative members and non-members overall show a strong association between cooperative membership and income aspirations as well as the factors considered to be relevant for the formation of aspirations. However, it is inconclusive to already draw inferences from these descriptive comparisons as they do not control for confounding factors and potential endogeneity.

3.5 Results and discussion

Checking the validity of the instrument, we find a highly significant relationship between the instruments and cooperative membership as shown in the first stage IV regression (Table A8 in the appendix), suggesting that the instruments are relevant. Further, we obtain the Kleibergen-Paap rk Wald F-statistic of 28.43, which is above the threshold value of 16.38 based on the derivation of Stock and Yogo (2005). For the second instrument validity condition, exogeneity, it is usually not possible to test if the instrument correlates with the omitted variables (which are usually unknown). However, given that we have two instruments, we can test whether the instruments are uncorrelated with the error term by performing the Wooldridge's score test of overidentifying restrictions, which is heteroscedasticity-robust (Wooldridge, 1995). Both models are statistically insignificant at the 5% significance level, thus, we fail to reject the null hypothesis that the instruments are valid. We also obtain some insights about this by looking at the correlation of the instrument with the outcome variable and other observed covariates. As shown in Table A9 in the

appendix, we obtain no statistically significant association between the instrument with the income and asset aspirations even when limiting the correlation analysis to non-members only. Given the various test and checks, our instruments seem to be valid but given that we are using cross-sectional data, we acknowledge that eliminating all sources of endogeneity is a challenge.

3.5.1 Effects of cooperative membership on income and asset aspiration

Table 3.3 provides the estimated effects of cooperative membership on income aspirations (full model results are shown in Table A10 in the appendix). Results are provided both for the ordinary least squares (OLS) and the instrumental variable regression. As hypothesized, cooperative membership has a positive effect on income aspirations and this is statistically significant at the p=0.01 level. Cooperative membership increases income aspirations by 38 percentage points. Our findings are new and highly significant when compared to those of Mojo et al. (2016), who could not statistically reject a 'no-effect'. Similar insights were also brought forth by and Garcia et al. (2020) when looking at how a group micro-credit lending scheme improves aspirational hope in Sierra Leone. Of course, these findings can be attributed to the benefits that accrue with group membership, especially information flow, as well as increased access and coordination (Ray, 2006). Since group members regularly interact among themselves and channel relevant information from development experts to members in their group, it is highly probable that such interactions form the basis of the formation of rural aspirations. This insight is confirmed by Macours and Vakis (2014) in their randomized experiment in Nicaragua, where they show that social interaction on a group basis changes

households' behaviour towards the future. Of course, these happen by altering the aspiration window.

Table 3.3 Effect of cooperative membership on income aspirations

	(1)	**(2)**	**(3)**	**(4)**
	OLS	**2SLS**	**OLS**	**2SLS**
Cooperative	0.392***	0.727***	0.103	0.379***
membership	(0.089)	(0.189)	(0.072)	(0.154)
Constant	10.160***	10.076***	6.109***	6.158***
	(0.047)	(0.061)	(0.637)	(0.622)
Ward dummies	Yes	Yes	Yes	Yes
Other controls	No	No	Yes	Yes
Kleibergen-Paap rk Wald F-stat		23.39		28.43
Kleibergen-Paap rk LM P-values		0.000		0.000
R squared	0.032	0.088	0.423	0.406
Observations	530	530	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, household income, life satisfaction, internal locus of control, external locus of control. The controls are included to increase the precision of the regression estimates. The dependent variable is income aspiration and the instrumental variable used in the 2SLS regression is the village cooperative membership rate.

We also observe that cooperative membership has a positive effect on asset aspirations (Table 3.4). The effect size is very similar to income aspirations. The results are statistically significant overall specifications with some changes in magnitudes. When not controlling for the possible endogenous effect of cooperative membership, the effect is just 20 percentage points, increasing to 46 percentage points in the 2SLS model. Similar to the income aspiration model, the results demonstrate underestimated effects when not controlling for potential endogeneity.

Table 3.4 Effect of cooperative membership on asset aspirations

	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Cooperative membership	0.551***	0.700***	0.200*	0.464***
	(0.124)	(0.249)	(0.646)	(0.218)
Constant	12.187***	12.150***	8.800***	7.171***
	(0.068)	(0.088)	(0.646)	(0.723)
Ward dummies	Yes	Yes	Yes	Yes
Other controls	No	No	Yes	Yes
Kleibergen-Paap rk Wald F-stat		148.54		28.95
Kleibergen-Paap rk LM P-values		0.000		0.000
R squared	0.031	0.029	0.329	0.353
Observations	530	530	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, asset level, life satisfaction, internal locus of control, external locus of control. The controls are included to increase the precision of the regression estimates. The dependent variable is asset aspiration and the instrumental variable used in the 2SLS regression is the village cooperative membership rate.

3.5.2 Mechanism

For exploring the mechanism through which cooperative membership increases aspirations, recall that we posited in section 2 the role-modelling effect on aspirations, for which cooperative membership may be vital. In such groups, there usually occurs information flow between individuals, village leaders, reference farmers and other community leaders. In this context, they can be regarded as role models. We test this relationship by replacing the cooperative membership variable with a variable proxying for interaction with role models. For both income and asset aspirations, we find that farmers who interacted with role models have higher aspirations. Specifically, farmers who interacted with role models have an income and

asset aspiration of 0.259 and 0.235 standard deviations higher than households with no interaction with role models.

To be sure this effect is indeed driven by cooperative membership, we restricted the sample to only cooperative members, for whom we still obtain similar insights (Table 3.5). Our results, therefore, provide support of the role-model effect on aspirations given that the same control variables have a significant association with aspirations. We also observe larger estimated coefficients for the role-modelling effect.

Table 3.5 Estimation results exploring the role-model mechanism

	Income aspirations		**Asset aspirations**	
	(1)	**(2)**	**(3)**	**(4)**
Exposure to role model	0.259***	0.378**	0.235**	0.411*
(1=Yes)	(0.075)	(0.163)	(0.116)	(0.235)
Constant	6.416***	6.315***	8.914***	9.074***
	(0.363)	(0.639)	(0.495)	(0.805)
F statistic	56.11	12.50	35.94	9.60
Prob > F	0.000	0.000	0.000	0.000
Adjusted R squared	0.422	0.378	0.316	0.313
Other controls	Yes	Yes	Yes	Yes
Full model	Yes	No	Yes	No
Observations	530	133	530	133

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, asset level, life satisfaction, internal locus of control, external locus of control. The controls are included to increase the precision of the regression estimates. The model is estimated using OLS. Full estimation results are presented in Table A5 in the appendix.

From the above framework, one may argue that we only tested whether exposure to role models affects aspirations and not whether this is driving the result on cooperatives. It may thus be worthwhile to have both cooperative membership and exposure to role models in the same regression

model. We perform the normal 2SLS regression controlling for exposure to role models. Additionally, we interact cooperative membership with exposure to role models and test whether the interaction term is significant. The results presented in Table 3.6 show a positive and statistically significant interaction term. This indicates that role models have a larger effect on cooperative members than on non-members.

Table 3.6 Interaction effect between cooperative membership and role models

	Income aspirations		**Asset aspirations**	
Cooperative membership (1=Yes)	0.383*** (0.150)		0.467*** (0.215)	
Exposure to role model (1=Yes)	0.272*** (0.077)		0.262*** (0.104)	
Interaction term		1.524*** (0.651)		1.865*** (0.913)
Constant	6.292*** (0.615)	6.458*** (0.673)	7.301*** (0.723)	0.739*** (0.797)
F statistic	22.91	13.08	28.16	15.32
Prob > F	0.000	0.000	0.000	0.000
Adjusted R squared	0.422	0.364	0.359	0.297
Other controls	Yes	Yes	Yes	Yes
Observations	530	530	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, asset level, life satisfaction, internal locus of control, external locus of control. The controls are included to increase the precision of the regression estimates. The model is estimated using OLS.

To further assess this mechanism, we employ the framework of Acharya et al. (2016). This framework[9] assesses whether a mediator variable (in our case interaction with role models) is a mechanism that explains the outcome. Statistically speaking, the method determines whether the mediator is the only route that explains the outcome.

Computationally, the method consists of estimating the outcome regressions with the control variables, treatment variable and the mediator variable. For this, we subtract the estimate of the mediator variable from the outcome variable to generate a new variable.[10] The generated variable is now regressed with the control variables and the treatment variable. The parameter estimate of the treatment variable then provides evidence on whether the mediator variable is the only mechanism through which the treatment is associated with the outcome. The rule here to establish if this is the case is to fail to reject the null hypothesis that the treatment does not matter after controlling for the mediator variable.

We estimate two different equations for income and asset aspiration following Acharya et al.'s (2016) framework (Table 3.7). In all the cases, we find statistically insignificant effects and fail to reject the null hypothesis of no significant relationship between cooperative membership and aspirations after controlling for the effect of role models. This provides suggestive evidence that interaction with role models is a crucial mechanism[11] whereby cooperative membership is associated with an

[9] It is also known as sequential g-estimation. It is an intuitive, straightforward and east to implement procedure that calculates direct effects, though relying on weaker assumptions.
[10] In this procedure, we assume that all the control variables are pre-treatment variables so we did not need to subtract the estimate coefficients of the post treatment variable.
[11] Comparing this with the OLS regressions, we see that statistical significance reduces in the case of asset aspirations but the magnitudes greatly reduce for both income and asset

increase in income and asset aspirations. Previous studies (Beaman et al., 2012; Bernard et al., 2019; Macours and Vakis, 2009; Riley, 2018) have pointed out this finding, highlighting the role of role models on aspirations and other social and economic outcomes.

Table 3.7 Exploring the role-model mechanism using sequential g-estimation

	Income aspirations	**Asset aspirations**
Cooperative membership	0.018	0.032
(1=Yes)	(0.084)	(0.127)
F statistic	10.91	8.39
Prob > F	0.000	0.000
Adjusted R squared	0.434	0.364
Other controls	Yes	Yes
Observations	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, asset level, life satisfaction, internal locus of control, external locus of control. The controls are included to increase the precision of the regression estimates. The model is estimated using OLS.

3.5.3 Robustness checks

To validate our findings, we perform some robustness checks. First, we verify the robustness of the second IV by using two other distance buffers. In principle, if the arguments on the number of cooperative members around every representative household hold as a conduit of participation in cooperatives, the estimated coefficient of cooperative membership on aspirations using these two buffers should not only also be positive and

aspirations. This confirms the findings of the IV regression with the addition of role models.

statistically significant, but also very similar to the estimated effects with the original instrument. In fact, the effect should be strongest, and reduce as the distance between the cooperative members and the representative household increases. To test this, we use additional buffers of 2km and 5km around each household and calculate[12] the number of aware households in each buffer. As shown in Table 3.8, we indeed observe the strongest effect in the 2km buffer, which attenuates towards the 5km buffer. This possibly signals social learning, or, more likely, a neighbourhood effect diminishing with distance. Our estimated effects here are quite similar to the main effects. This finding further supports and bolsters our claim that membership in cooperatives increases income and asset aspirations.

Table 3.8 Testing alternative instrumental variables

	Income aspiration	**Asset aspiration**
Number of cooperative members	0.487**	0.751**
(2km)	(0.229)	(0.324)
Number of cooperative members	0.462**	0.650**
(5km)	(0.184)	(0.277)
Household controls	Yes	Yes
Prob (chi2)	0.000	0.000
Observations	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, asset level, life satisfaction, internal locus of control, external locus of control. The controls are included to increase the precision of the regression estimates. The model is estimated using 2SLS.

As a second check, we use doubly robust estimators. Previous literature (Garcia et al., 2020; Mojo et al., 2016) controlled for the endogeneity of

[12]Since we have the GPS coordinates of all households, we used the geonear package in STATA to calculate geodetic distances between the households.

group membership by using matching estimators like propensity score matching (PSM) which creates a comparable counterfactual of group membership and matches farmers in the two groups. Being a selection on observables estimator, it is conditional on observable factors and reduces bias based on observable characteristics. Despite this, PSM can still produce biased results when the propensity-score model is misspecified (Robins et al., 2007; Wooldridge, 2007). Potential remedies for this are the doubly robust estimators like Inverse Probability Weighting Regression Adjustment (IPWRA) and Augmented Inverse Probability Weighting (AIPW). IPWRA combines the weighting estimator (inverse probability weighting) and regression adjustment (RA) to produce consistent and unbiased effect estimates. Being doubly robust, they will produce consistent estimates when either the treatment or the outcome model is correctly specified (Wooldridge, 2010).

Two assumptions critical to the use of these estimators are the balance assumption and the overlap assumption. To verify whether we achieve balance after our weighting procedure, we conduct an over-identification test as suggested by Imbens and Wooldridge (2009). Based on the test statistic reported in Table 3.9, we conclude that our weighting samples are balanced. We also calculated the normalized differences for each of our explanatory variables and found them to be relatively small (full results are presented in Table A13 in the appendix). Additionally, the variance ratios are close to 1 for all the covariates. For the overlap condition, none of our observations have a probability above and below the 0 and 1 thresholds, indicating the overlap condition is met. Our results should therefore be in order.

Across the weighting and doubly robust specifications, we find cooperative membership to be significantly related to income and asset aspirations (Table 3.9). As expected, the signs are positive, implying significant gains of cooperative membership. Although the magnitudes are somewhat smaller than the IV regressions, they are all in the same direction, suggesting a positive relationship between group membership and income and asset aspirations.

Table 3.9 Weighting and doubly robust estimates of aspirations

	IPW	**IPWRA**	**AIPW**
Income aspirations			
Cooperative membership	0.274***	0.252***	0.188**
(1=Yes)	(0.100)	(0.093)	(0.105)
Chi square (χ^2)	4.581	4.581	4.581
p-value	0.869	0.869	0.869
Asset aspirations			
Cooperative membership	0.315**	0.263**	0.243**
(1=Yes)	(0.136)	(0.129)	(0.131)
Chi square (χ^2)	3.807	3.807	3.807
p-value	0.923	0.923	0.923
Other controls	Yes	Yes	Yes
Observation	530	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1. Other controls include the age of the household head, the educational level of the household head, asset level, life satisfaction, internal locus of control, external locus of control.

3.6 Conclusion and policy implications

The study of aspirations and their role in future-oriented behaviour is becoming increasingly relevant from an economic point of view. While theoretical literature has already established its links to poverty and inequality with burgeoning support from recent empirical analysis, less attention has been placed on how aspirations are formed. That

notwithstanding, it has been established that aspirations are a social construct that is socially determined and formed in the thick of life. Individuals build their aspirations through social interaction on a group basis, or, better still, individuals shape and update their aspirations based on their aspiration window. Hypothesizing that aspirations are formed by interactions in groups, this paper examines the role of cooperative membership on income and asset aspirations of households using a cross-sectional survey of 530 farm households in Kenya.

Mindful of possible selection into cooperative membership, the study employed an instrumental variable-regression approach with the specification of a spatially-based and a distance-based instrument. The use of different instruments allowed us to test not only the validity conditions of the IV, but also exogeneity using Wooldridge's robust score test of overidentifying restrictions. Starting with descriptive statistics and mean differences, cooperative members were found to be significantly different from non-cooperative members based on observed socio-economic and household characteristics. The IV regressions further confirm these insights, establishing a positive association between cooperative membership and income and asset aspirations. The findings are robust over different specifications including doubly robust and weighting estimators. We further explore the mechanism behind this positive association between cooperative membership and aspirations. In line with the growing literature (Beaman et al., 2012; Bernard et al., 2019; Macours and Vakis, 2009; Riley, 2018) on the importance of role models in shaping individual internal characteristics, we find exposure to role models to mediate this relationship.

Our findings open a novel empirical insight into the important role of cooperative groups in increasing aspirations, mediated by exposure to role

models in the context of a rural setting. These agriculturally centred social constructs are pervasive throughout SSA and their importance for villagers is immense as they promise social and economic mobility within the practical reach of individuals. Based on our findings, we lend support to the development of financial and institutional mechanisms that can increase households' access to cooperative membership as this has the possibility of widening their aspiration window and subsequently improving their aspirations and future-oriented behaviour. In this regard, programmes and interventions tackling external constraints may be instrumental in relaxing the constraints most rural households face in accessing information capable of widening their reference set and aspirational window. Addressing these external constraints may go a long way to offset and alter the internal constraints (lack of aspirations) that households face in improving their future-oriented outcomes.

Now that we have established the mechanism through which cooperative membership increases aspirations, we are curious whether these results are heterogeneous depending on the type of cooperative, and even the size of the cooperatives. One may argue that smaller cooperatives make for more intimate and intense interaction between members. If this is the case, we expect aspirations to be larger for small cooperatives. Whether this is true is an interesting area for further research as our data do not permit us to verify this heterogeneity.

It is important to guide the understanding of this study from a rural perspective. The findings should not be generalized, but understood from an African smallholder farming perspective. Even though rural households may aspire in a larger set of aspirational dimensions, the study utilizes just the income and asset aspirations, which may not engender the aspirations of

smallholder households. It may thus be important to understand in a broader way how group membership builds other dimensions of aspirations. Furthermore, as aspirations are attitudinal and dynamic, it may be worthwhile for future research to study their formation in a more controlled setting and under different time periods.

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3.8 Appendix

Table A8 First stage IV regressions of income and asset aspirations

	Income aspirations	**Asset aspirations**
Village cooperative membership	1.386***	1.386***
	(0.147)	(0.147)
Number of cooperative members (1km)	-0.030***	-0.030***
	(0.010)	(0.010)
Age of head (years)	0.002	0.002
	(0.013)	(0.013)
Education of head (years)	0.010**	0.010**
	(0.004)	(0.004)
Income (Ksh)	0.001	0.001
	(0.017)	(0.017)
Asset (Ksh)	0.021*	0.021*
	(0.012)	(0.012)
Life satisfaction (1=Yes)	-0.068***	-0.068***
	(0.025)	(0.025)
Internal Locus of control	0.103	0.103
	(0.076)	(0.076)
External Locus of control	0.001	0.001
	(0.072)	(0.072)
Adjusted R squared	0.284	0.284
P value of overidentification test	0.071	0.196
Observations	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table A9 Correlation between instruments and aspirations

	Income aspiration		Asset aspiration	
	(1)	**(2)**	**(3)**	**(4)**
Village cooperative. membership rate	0.191	0.173	0.130	0.115
Number of cooperative members (1km)	0.204	0.188	0.139	0.137
Number of cooperative members	0.167	0.160	0.079	0.078
Comparison group	No	Yes	No	Yes

Note: For the comparison group, we only include farmers who are not cooperative members. None of the correlation coefficients is statistically significant at the 1% level of probability.

Table A10 Effect of cooperative membership on income aspirations (full results)

	(1)	**(2)**	**(3)**	**(4)**
Cooperative	0.392***	0.727***	0.103	0.379***
membership	(0.089)	(0.189)	(0.072)	(0.154)
Age of head (years)			-0.004	-0.003
			(0.002)	(0.002)
Education of head			0.031***	0.029***
(years)			(0.009)	(0.009)
Income (Ksh)			0.374***	0.367***
			(0.068)	(0.066)
Asset (Ksh)			0.044*	0.039
			(0.025)	(0.024)
Life satisfaction			0.072	0.081
(1=Yes)			(0.052)	(0.052)

Internal Locus of			0.219	0.159
control			(0.141)	(0.143)
External Locus of			-0.064	-0.082
control			(0.142)	(0.142)
Constant	10.160***	10.076***	6.109***	6.158***
	(0.047)	(0.061)	(0.637)	(0.622)
Estimation	OLS	2SLS	OLS	2SLS
Ward dummies	Yes	Yes	Yes	Yes
Other controls	No	No	Yes	Yes
Kleibergen-Paap rk Wald F-stat		23.39		28.43
Kleibergen-Paap rk Wald F-stat		0.000		0.000
R squared	0.032	0.088	0.423	0.408
Observations	530	530	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table A11 Effect of cooperative membership on asset aspirations (full results)

	(1)	**(2)**	**(3)**	**(4)**
Cooperative	0.551***	0.700***	0.200*	0.464**
membership	(0.124)	(0.243)	(0.646)	(0.218)
Age of head (years)			-0.005	-0.002
			(0.003)	(0.003)
Education of head			0.045***	0.031**
(years)			(0.013)	(0.013)
Income (Ksh)			0.256***	0.249***
			(0.056)	(0.069)
Asset (Ksh)			0.313***	0.248***
			(0.058)	(0.054)

Life satisfaction (1=Yes)			-0.074	-0.011
			(0.075)	(0.074)
Internal Locus of control			0.576**	0.485**
			(0.237)	(0.234)
External Locus of			-0.400*	-0.432**
control			(0.221)	(0.209)
Constant	12.187***	12.150***	8.800***	7.171***
	(0.068)	(0.088)	(0.646)	(0.723)
Estimation	OLS	2SLS	OLS	2SLS
Ward dummies	Yes	Yes	Yes	Yes
Other controls	No	No	Yes	Yes
Kleibergen-Paap rk		148.54		28.95
Wald F-stat				
Kleibergen-Paap rk		0.000		0.000
Wald F-stat				
R squared	0.031	0.029	0.329	0.353
Observations	530	530	530	530

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1.

Table A12 Estimation results exploring the role model mechanism (full results)

	Income aspirations		**Asset aspirations**	
	(1)	**(2)**	**(3)**	**(4)**
Exposure to role model	0.259***	0.378**	0.235**	0.411*
(1=Yes)	(0.075)	(0.163)	(0.116)	(0.235)
Age of head (years)	-0.004*	-0.003	-0.006*	0.004
	(0.002)	(0.005)	(0.003)	(0.007)
Education of head (years)	0.038***	0.025*	0.049***	0.023
	(0.008)	(0.015)	(0.013)	(0.021)
Income (Ksh)	0.396***	0.428***		
	(0.028)	(0.054)		
Asset (Ksh)			0.313***	0.333***
			(0.030)	(0.054)
Life satisfaction (1=Yes)	0.019	0.049	-0.117	-0.356**
	(0.049)	(0.096)	(0.076)	(0.138)

Internal Locus of control	0.221	-0.021	0.564**	0.334
	(0.146)	(0.288)	(0.226)	(0.415)
External Locus of control	-0.058	0.043	-0.385*	-0.004
	(0.137)	(0.268)	(0.212)	(0.391)
Constant	6.416***	6.315***	8.914***	9.074***
	(0.363)	(0.639)	(0.495)	(0.805)
F statistic	56.11	12.50	35.94	9.60
Prob > F	0.000	0.000	0.000	0.000
Adjusted R squared	0.422	0.378	0.316	0.313
Full model	Yes	No	Yes	No
Observations	530	133	530	133

Notes: Robust standard errors are in parentheses; *** p<0.01, ** p<0.05, * p<0.1

Table A13 Summary of Covariate balance

	Standardized differences		**Variance ratio**	
	Raw	**Weighted**	**Raw**	**Weighted**
Village cooperative membership rate (1=Yes)	1.268	0.173	1.053	0.859
Number of cooperative members in a 1km buffer	0.781	0.129	1.385	0.929
Age of head (years)	-0.397	-0.036	0.625	0.874
Education of head (years)	0.392	0.013	0.852	0.894
Assets (Ksh)	0.356	0.037	1.035	1.638
Life satisfaction (1=Yes)	-0.116	-0.179	1.140	1.000
Internal Locus of control	0.316	0.038	0.935	0.965
External Locus of control	0.076	-0.075	0.971	0.968

Notes: In the raw data form, the number of cooperative members is 133 with 397 controls. After weighting, we obtain 244 cooperative members and 286 controls.

Chapter 4

Religiosity and parental educational aspirations for children in Kenya[13]

Abstract

Poor households make little investments in human capital, despite the potential benefits, and are hence trapped in poverty. To overcome this poverty trap, households can invest more in children's education, as such investments reflect hopes and aspirations to break the intergenerational poverty chain. In this study, we examine the relationship between religiosity and parental educational aspirations for their children in rural Kenya. We study religiosity from both an extensive (membership in a religious institution) and an intensive perspective (extent of personal spiritual practice such as engaging in worship, meditating and prayer) and elicit parental aspirations for children using vignettes. By employing inverse probability weighting with regression adjustment and multivalued treatment-effects estimators on cross-sectional data, we show that membership in a religious institution and higher levels of religiosity increase the educational

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aspirations of parents for their children, and for girls in particular. Overall, we provide empirical correlational evidence that religion can be a transformative pathway for socio-economic development through nudging aspirations and loosening internal constraints and activating progressive beliefs about development in many rural African settings.

Keywords: Religious institution; Religiosity; Educational aspirations; Kenya

JEL classification codes: Z12, Z13, D83, D91, C83

4.1 Introduction

Poor households generally have marginal involvement in human capital investments such as education, possibly due to overall low aspirations and expectations (La Ferrara, 2019), partly emanating from constrained economic and material resources (Appadurai, 2004). Hypotheses for low investment in human capital by poor households have included psychological stress due to financial constraints, information asymmetry on returns to education, and the disadvantages associated with low exposure as a result of narrow social environments. From an educational attainment perspective, parental aspirations are essential. They determine education investment in children (Janzen et al., 2017; Serneels & Dercon, 2021), and signal a desire to break the intergenerational cycle of poverty (Genicot & Ray, 2017, 2020; Lee et al., 2012).

A key concern, therefore, is how aspirations can be nudged to improve development outcomes such as human capital. What are some of the inputs into one's psychological and physical aspiration window that can influence aspiration formation? The literature here can be divided into studies assessing psychological inputs into belief formation (Beaman et al., 2012; Bernard et al., 2019; Boneva & Rauh, 2018; Glewwe et al., 2018; Golan & You, 2020; Mckenzie et al., 2021) and those studying material, budget-relaxing interventions (Chiapa et al., 2012; Garcia et al., 2020; García et al., 2019; Kosec & Mo, 2017; Macours & Vakis, 2014; Suarez & Cameron, 2020; Whetten et al., 2019; Zou et al., 2020). One understudied issue is the role of beliefs in the formation of aspirations. This study therefore assesses the role of religion and religiosity on aspirations, with a precise focus on parental aspirations for the education of their children.

Our study is situated in rural Baringo County in Kenya among agro-pastoral households. We use a cross-sectional survey and incorporate gender-separated vignette experiments about parental educational aspirations for children. We measure the influence of religiosity both from an extensive (membership in a religious institution (hereafter RI)) and an intensive dimension (extent of participation in religious activities and more personal religiosity attributes). Applying inverse probability weighting with regression adjustment, we find that religiosity increases parental educational aspirations for children in general and for girls in particular. The results are robust to other doubly robust estimators as well as various sensitivity and robustness checks.

Our study contributes to the literature assessing psychological inputs of aspirations formation, especially those assessing the role of religion (Bryan et al., 2020; Glewwe et al., 2018; Ross et al., 2021; Valdes et al., 2020; Wydick et al., 2013). In doing so, we make two key additions. First, is the manner in which we measure religiosity. While these studies use robust experimental identification, randomizing intrinsic values such as beliefs or religiosity is an intricate matter. We believe these are better observed than experimented with, because beliefs might not be easily dichotomized but can rather exist on a spectrum of intensity. We therefore use a simple yet more appropriate assessment of religiosity, which captures religious beliefs along a continuum. From a set of questions, we develop a religiosity index and evaluate the role of religion from both an extensive (membership) and an intensive (level of practice) dimension. Secondly, our study assesses parental aspirations using vignettes. This prevents parental favouritism and biases in parents' evaluation of their real children. This is the case since vignettes are used in eliciting complicated household dynamics such as intra-household decision-making (Bernard et al., 2020). Since we ask each

household their rating of educational aspirations for both boys and girls, we can observe differences across genders without conditioning households/parents to having both genders of children. Moreover, we also capture the individual beliefs of adults whether or not they had a child in the household.

This paper is relevant for development policy in various ways. In countries like Kenya, religious practice has increased and religion continues to play a key role in the daily lives of people. To expand conditions for development, it therefore seems useful to explore the complementarities of a growing institution/ practice with a secular development agenda. This research in this regard contributes to theories and observational critical studies that suggest the inclusion of religion and faith in development policy (Haynes, 2007; Lunn, 2009; Tomalin, 2018). Secondly, in countries like Kenya, faith-based organizations play a key role in social services and overall development. Faith-based organizations partly draw their position from the historical expansion of Christianity through Western missionaries and also from the more recent growth of Pentecostalism (Omenyo, 2017). And yet faith-based organizations remain largely on the periphery of development policy and less is known about their value addition (Clarke & Ware, 2015; Tomalin, 2012). This paper therefore sheds more light on the value addition of religious-inclusive interventions, especially those seeking to motivate internal constraints of development outcomes.

The rest of the article is structured as follows: Section 4.2 discusses aspirations and development and Section 4.3 delves into the historical role of religion in development and religion-focused interventions in aspirations formation from recent research. Section 4.4 contains the data and

measurement of variables and the empirical methods in this paper. Section 4.5 provides the results and robustness checks, and Section 4.6 concludes.

4.2 Aspirations and Development

The role of behavioural biases and internal constraints in explaining poverty and economic outcomes is increasingly becoming central to poverty-reduction interventions (Besley, 2017). One specific form of this behavioural bias stems from aspirations (Appadurai, 2004; Ray, 2006). Aspirations are essential predictors of human-capital achievement and economic outcomes through their influence on economic behaviour (Genicot & Ray, 2020). However, aspirations vary in a population and are strongly linked to one's poverty status and material endowments (Camfield et al., 2013; Chivers, 2017; Lybbert & Wydick, 2018; Pasquier-Doumer & Brandon, 2015; Serneels & Dercon, 2021; Tabe-Ojong et al.,2021; Wuepper & Lybbert, 2017). Recent development interventions have therefore incorporated aspirational modules in their intervention continuum as a pathway to nudge aspirations as a channel toward poverty reduction (Bernard et al., 2019; Bryan et al., 2020; Janzen et al., 2017; Mckenzie et al., 2021).

The critical point from which to start in understanding aspirations is the concept of 'the capacity to aspire'[14] (Appadurai, 2004). Given the limitations to aspirations (such as shocks, poverty and general material endowments), the capacity to aspire is determined by an individual's

[14] This concept implies that the aspiration window must be opened to internalize some efforts for any welfare improvement to occur. But again, the window should not be binding or very wide so as not to induce frustration and resentment. High aspirations with limited achievement are likely to generate frustration (Mckenzie et al., 2021)

capacity to fully explore the possibilities around them by repeatedly interacting with members in their social network. As such, "aspirations are never simply individual… they are always formed in interaction and in the thick of social life" (Appadurai, 2004, p. 68). Through observation and personal experiences, individuals broaden their aspiration windows within specific reference groups (Genicot & Ray, 2020; Ray, 2006, 2016). A question however remains as to how aspirations can be nudged or improved. The literature on aspiration improvements can be divided into two sets. The first set considers the theory that aspirations are based on an individual's network (Appadurai, 2004; Ray, 2006), and therefore altering one's social network with higher aspiration anchors can improve their aspirations. Several studies, therefore, assess psychological and non-physical inputs into aspiration formation. One avenue of nudging aspirations is through role models (Beaman et al., 2012; Bernard et al., 2019; Golan & You, 2020; Macours & Vakis, 2014; Mckenzie et al., 2021). The second set of studies relates to physical, budget-relaxing interventions on the enabling side and the role of shocks in curtailing the capacity to aspire. These include cash transfers (Chiapa et al., 2012; García et al., 2019; Kosec & Mo, 2017; Macours & Vakis, 2014; Whetten et al., 2019), micro-credit (Garcia et al., 2020) and early childhood interventions (Zou et al., 2020). Kosec & Mo (2017) and Tabe-Ojong et al. (2021) further show that natural disasters and ecological shocks curtail people's capacity to aspire.

4.3 The role of religion in the development of aspirations

Research on the role of religion in development is continuously evolving, emanating from Max Weber's 19th-Century sociological theory of the Protestant Ethic as a key driver of the industrial revolution in Western Europe (Weber, 2001). Economists have continued to test this theory in

various dimensions, with increasing confirmation that communities that experienced protestant reformation earlier had higher literacy and economic prosperity (Becker, 2008; Becker & Woessmann, 2009) especially through the desire for Bible reading (Woodberry, 2012) and thus growth of technologies such as printing presses (Cagé & Rueda, 2016). The effects of early Christian missionary activity on education outcomes seems to persist even up until today (Gallego & Woodberry, 2010). Furthermore, the exportation of missionary work was accompanied by increased urbanization (Bai & Kung, 2015) and challenged norms about women's labour-market participation (Meier zu Selhausen, 2014) and marriage timing for young women (Kudo, 2017). At a macro level, economic and sociological studies have shown that countries with higher levels of religious beliefs exhibited higher economic growth rates (Barro & McCleary, 2003; McCleary & Barro, 2006, 2019).

Recently, charismatic, often Pentecostal Christianity has emerged as the new frontier for Weber's thesis in developing countries (Frahm-Arp, 2018; Freeman, 2015; Gifford & Nogueira-Godsey, 2011; Kirby, 2019; Togarasei, 2011) and recent empirical studies support the relationship between religious belief and religious-based interventions and future-oriented behaviours. Studies have found that religious-based (Christian) interventions increased economic welfare and household consumption (Bryan et al., 2020), happiness, self-efficacy and hope (Glewwe et al., 2018; Valdes et al., 2020; Wuepper & Lybbert, 2017; Wydick, Dowd, & Lybbert, 2020). International Christian child-sponsorship programmes have also been shown to increase schooling outcomes through higher aspirations (Ross et al., 2021; Wydick et al., 2013). The key thread in these studies is that exposure to religious teaching unlocks individuals' internal psychological limitations and enables socio-economic progress.

Previous studies assessing parental educational aspirations for children in low-income countries have generally concentrated on socioeconomic factors or parents' own beliefs about their children's capacities (Bernard et al., 2019; Favara, 2017; Oketch et al., 2012). This paper therefore attempts to elucidate the rather overlooked link between religion/ religiosity and parental educational aspirations. Exposure to religious teaching and practice can raise aspirations through several pathways. First, the recent growth of Pentecostal theology of prosperity challenges individuals to confront the adverse circumstances of their poverty (Conradie & Robeyns, 2013). Individuals tend to believe that they can live a "glorious life" (Fantini, 2016; Gifford & Nogueira-Godsey, 2011) and that earthly material accumulation such as property is an indication of blessings (Adu-Gyamfi, 2020). Individuals receive messages that positively influence their esteem and self-efficacy (Mariz, 1992; Ross et al., 2021), thereby increasing their economic and civic participation (McClendon & Riedl, 2015). More recently, recent religious literature has tended to become motivational and aspirational, turning previously complex religious texts into goal-oriented and materially focused texts (Bloem, 2017; Schneider & Dornbusch, 1957).

Secondly, religious membership and participation provide an additional capital – faith/ spiritual capital, defined as a 'fund of beliefs, examples and commitments transmitted through religious practice and which attach people to transcendental sources of happiness' (Malloch, 2014). Spiritual capital is associated with how religious practice influences economic behaviour through social networks and associations (DeAngelis & Ellison, 2018; Dumangane, 2017; Holland, 2016; Lim & Putnam, 2010; Neubert et al., 2017; Strhan, 2017; Yuen & Leung, 2019).

Thirdly, previous research (Beaman et al., 2012; Bernard et al., 2014; Bernard et al., 2019; Golan & You, 2020; Lybbert & Wydick, 2018; Macours & Vakis, 2014) has shown that exposure to role models or leaders in a community can build aspirations of rural households through increasing people's aspiration windows. Through religious social networks, individuals are exposed to clerics and elders who act as role models in influencing actions and behaviours such as goal setting (Anquandah Arthur, 2021; Bhatasara et al., 2017), information sharing (Murphy et al., 2020) and adoption of material desires approved by their theology (Anquandah Arthur, 2021; Togarasei, 2011). In these groups, members are exposed to reference leaders and role models, which improves their aspirations.[15] Social exposure further improves information flow, allowing individuals to more fully engage in a diverse set of investment options to meet stated goals.

4.4 Data and empirical strategy

4.4.1 Data

Kenya is a predominantly Christian country. About 91.4 percent of women and 88.9 percent of men are Christians, with protestant Christians making up 75.9 percent of men and 77.9 percent of women (KNBS et al., 2015). However, Kenya also has a wide variation in ethnicities which have been exposed to Christian beliefs differently (Iyer & Weeks, 2020). Our study is situated in Baringo County, a region that is at the heart of this ethnic and religious mix. While one ethnic group, the Tugens, have been highly Christianized, the Pokot and the Ilchamus ethnic groups largely adhere to

[15] Social exposure triggers social interaction, which increases the navigational capacity of individuals necessary to form aspirations. Since individuals usually have bounded rationality, exposure enlarges the set of alternative options that they consider (Chiapa et al., 2012).

traditional African beliefs (IFAD, 2012; Matwetwe, 2017) and have to some extent rejected Christianization (Ngeiywo, 2018). This religious landscape therefore gives us a more natural way of studying the possible effect of religion and religiosity on aspirations, exploiting the current levels of exposure to Christianity.

We use household survey data from Baringo county of Northern Kenya, conducted between July and August 2019. Multistage sampling was employed to select four wards (Marigat, Ilchamus, Mochongoi and Ewalel/Chapchap) and 35 enumeration areas (villages) using the Probability Proportional to Size (PPS) framework. The key sampling frame was a list of enumeration areas from the 2009 Kenya National Population and Housing Census, and sampling of enumeration areas was conducted with the support of the Kenya National Bureau of Statistics. Complete household lists were obtained from village leaders, and 15 households were randomly selected from each village. The total sample was 530 households. Interviews were conducted with the household heads or their partners. To leverage the respondents' language abilities, interviews were conducted in the area's local languages (Ilchamus, Tugen and Pokot languages). We trained research assistants and tested the survey instrument for several rounds before survey implementation.

The comprehensive survey included information on households' socio-economic and biographic profiles, wealth and asset profiles, institutional characteristics, and internal behavioural characteristics like hopes, aspirations, trust, locus of control, and self-efficacy. Information on the membership of households in RI was also obtained, as were data on their proximity to these institutions. Under aspirations, we captured the parental aspirations of parents towards their children using two vignettes. We

distinguish our outcome variable into two subsets: parental aspiration for girls and parental aspiration for boys. We discuss how these are measured below.

4.4.2 Measurement of aspirations

Educational aspirations are defined as the goals or plans parents have for their children. They can either be realistic or idealistic (Widlund, Tuominen, Tapola, & Korhonen, 2020), depending on the perceived constraints and range of attainment. While idealistic aspirations reflect an individual's desired achievement, realistic aspirations refer to the perceived likelihood of attaining the aspired educational level considering the various constraints involved. For our analysis, we rely on the idealistic aspiration as it fits our definition of aspirations.

We use a variation of Bernard & Taffesse's (2014) aspiration framework developed and tested in Ethiopia. We frame aspiration questions as vignettes that use fictional children instead of the actual children a respondent/ parent has. Vignette experiments are consistent in the measurement of hard-to-observe behaviour and beliefs such as in intra-households decision-making (Bernard et al., 2020). They are also commonly used in political science to study intrinsic behaviour such as voting choices (Gutierrez-Romero & Lebas, 2020) and corruption (Carreras & Vera, 2018; García-Ponce et al., 2021). Vignettes have also been recently recommended in studying issues related to aspirations, hope and expectations (Bloem et al., 2018). The use of vignettes not only mimics real-world behaviour (Hainmueller et al., 2015) but also helps us not to reduce our sample. We are therefore able to ask all eligible respondents about educational aspiration-related questions whether they had a child or not. Therefore, staying with this foundation, we

formulated our vignettes as follows: *'James is a son in this household. He is five years old. If there were no limitations to the household's capacity to educate him, how many years of schooling would you wish James to achieve?'* The enumerators were allowed to vary the name of the child to any locally recognizable name and also vary the age of the child to an age that was less or equal to 10 years. The vignette was then repeated for daughters such that for every household, two observations were recorded.

4.4.3 Religious belonging and religiosity

To measure religious belonging we posed a question – *'Do you belong to any religious group?'* – with a binary response. Beyond RI, one may argue that other aspects of religiosity also matter, especially those not observed by simple membership in a religious institution. This also matters as they can shape values, beliefs and economic decisions more. Moreover, even individuals who do not belong to any religious institution might have some religious practices and beliefs, such as praying or believing in the existence of God or higher powers. In particular, we asked individuals (i) the number of times they prayed in a day, (ii) the number of times in a week they visited a religious location for worship, (iii) how often they spent time in personal meditation including reading religious texts (Bible or Quran), (iv) whether they had ever experienced what they consider as divine experience with a supreme being, (v) number of interactions with a religious leader in the last seven days, (vi) distance to the place of worship, and (vii) the number of places of worship in the locality. From these seven questions, we developed a religiosity index as the first component from a principal-components analysis procedure. We then divided the index into three equal portions corresponding to (1) low religiosity, (2) moderate religiosity and (3) high religiosity.

4.5 Empirical specification

To examine the relationship between RI and parental aspirations for children, we need a counterfactual to enable credible comparisons. However, in the absence of experimental data, counterfactuals are not possible due to the self-selection of individuals in RI. Participants/ members of RIs might be systematically different from non-members. Matching on the propensity score provides a credible avenue of deriving casual associations when cross-sectional data is at hand. Matching helps us compare households that participate in RIs and those that do not but with a similar probability of participation derived from observable covariates. We apply a variation of matching – inverse probability weighting with regression adjustment (IPWRA) – which is both doubly robust and imposes fewer restrictions on the functional form of the treatment reduction model. Our outcome model is thus estimated as:

$$Y_i \quad = f(RI_i, \beta) + \ + u_i, \tag{1}$$

The treatment model is then represented as:

$$\Pr(T_i = 1,0) = h(\boldsymbol{X_i}, \alpha) + \ v_i, \tag{2}$$

RI is the binary measure of participation in RI, $\boldsymbol{X}$ is a vector of explanatory variables determining/constraining households' participation in RI. β and α are parameter estimates of the impact of RI on parental aspirations for children and the correlates of membership in RIs. Our main parameter of interest is β, where we hypothesize a positive relationship with aspirations, additionally differential impacts.

To calculate the doubly robust estimates of aspirations for household members and non-members in RIs, we estimate the following expected aspiration equations.

For members in RIs (RI=1), $\frac{Y_{RI=1}}{PS} - \frac{\widehat{Y_1}}{PS}(1 - PS)$ (3)

For non-members in RIs (RI=0), $\frac{Y_{RI=0}}{1-PS} - \frac{\widehat{Y_0}}{1-PS}(PS)$ (4)

Where PS refers to the propensity score, $Y_{RI=1}$ is the observed parental aspirations for members of RIs while $Y_{RI=0}$ is the observed parental aspirations for non-members of RIs. $\widehat{Y_1}$ and $\widehat{Y_0}$ are the predicted parental aspirations given membership status in RIs ($E(Y|RI = 1, \boldsymbol{X})$ and $E(Y|RI = 0,)$ X, respectively.

The advantages of the IPWRA doubly robust estimator lie in its ability to produce consistent estimates of the treatment parameters in cases where either the treatment or the outcome model, and not necessarily both, are correctly specified. Inverse probability weighting, akin to matching, generates a pseudo-population where there are no confoundings, such that the weighted averages are a mirror reflection of the actual population average. By incorporating regression adjustment, IPWRA fits separate linear models for households that participate in RIs and those that do not and then predicts the covariate-specific outcomes under the different RI status. Further and even more important is the fact that IPWRA enables us to model both aspiration outcomes when the treatment is a dummy (RIs) and also when multivalued (religiosity).

To ensure validity, we examine the common support condition and find evidence of common support, as shown in Figure A14 in the appendix.

Regarding the overlap condition for weighting regressions, we observe sufficient overlap after plotting the kernel densities of the probability of participating in a RI. We also perform different balance checks to assess pre-estimation balancing between treated and control units. As shown in Table A14 in the appendix, none of the weighting variables has a standardized difference greater than 0.11, which is within the conventional thresholds (Imbens & Wooldridge, 2009) without reducing our sample size. We perform a couple of sensitivity tests, introducing non-linearity, unconfoundedness, and alternative weighting and doubly robust estimators to confirm the robustness of the treatment effects.

4.6 Results and discussion

4.6.1 Descriptive results

Table 4.1 offers a descriptive summary of the outcome variables, the variable of interest, and the households' socio-economic profiles. The aspired-to mean years of schooling for girls was 18.12 years, slightly greater than for boys, at 18.10. Both aspiration levels are almost 2.2 times the current mean level of education of household heads, implying that parents aspire to a higher level of education for their children. Given the educational curriculum in Kenya, which consists of 8 years of primary-level education, four years of secondary education and four years of higher education, 18 years of schooling represents at least postgraduate education level. Parents thus aspire that their children reach the pinnacle of education. Irrespective of gender, parents have very high aspirations for children.

Table 4.1 Summary statistics of estimation variables

Variables	Mean	Std. Dev.	Min	Max
Outcome variables				
Aspirations for children	18.11	2.46	0	23
Aspirations for boys	18.10	2.45	1	23
Aspiration for girls	18.12	2.18	0	23
Independent variables				
Religious institution	0.70	0.45	0	1
Age (years)	45.15	15.62	18	104
Years of education	7.89	4.86	0	17
Head is male	0.74	0.43	0	1
Household size	5.93	2.82	1	15
Life satisfaction	2.36	0.67	1	4
Number of dependents	2.63	1.98	0	11
Access to electricity	0.39	0.48	0	1
Cooperative membership	0.25	0.43	0	1
Savings account	0.33	0.47	0	1
Farm size	1.29	1.79	0	20
Has a male child	0.57	0.49	0	1
Has a female child	0.53	0.49	0	1
Willingness to invest in agriculture	0.21	0.40	0	1
Livestock ownership (TLU)	3.18	5.07	0	60.7
Household income (Ksh)	10,887.6	13,330.2	1,000	120,000
Off-farm income (Ksh)	2,083.11	10,143.9	0	15,000
Asset value (Ksh)	171,532	1,055,13	5,000	2,030,00
Monogamous household	0.65	0.47	0	1
Polygamous household	0.12	0.33	0	1
Low religiosity	-2.30	0.74	-4.13	-0.15
Medium religiosity	0.65	0.33	-0.15	1.11
High religiosity	1.67	0.67	1.11	6.48
Christian	0.67	0.47	0	1
No religion	0.30	0.45	0	1

Notes: Ksh refers to Kenyan shillings, which is the local currency used in Kenya. Livestock ownership is measured in tropical livestock units (TLU) obtained using the FAO conversion scale for the different livestock. N=530 households. For the religiosity index we considered, the variables included are (i) praying times, (ii) worship times, (iii) meditation

times, (iv) divine experience with a supreme being, (v) interaction with religious leaders, (vi) distance to the place of worship, and (vii) the number of places of worship in the locality. For all these, we reported a Cronbach's alpha of 0.71.

About 70% of households participate in RI in Baringo county. Though religion is widespread in Kenya, the Pokot people that inhabit a large part of Baringo county have maintained a substantial composition of traditional religious practices (Ngeiywo, 2018). Therefore, about 30% of the sample were not affiliated with any Christian or Islamic denomination. Under the Christian canopy, there is a plurality of RI like the Catholic church and others that record the highest number of members. Recently, there has been an upsurge of religious entrepreneurism, which takes the form of many Pentecostal and charismatic denominations. While they are the smallest in absolute numbers, they are the fastest growing and their focus on material accumulation through the 'prosperity gospel' brings them closer to the religion-aspirations spectrum. However, we do not observe religious belonging at its most minute level. We categorize all Christian denominations into one group. Christian denominations together comprise 67%.

Turning our focus to households' knowledge and attendance in RIs in our sample, we find that households know an average of 5 RIs in the various locations[16] around their villages. Most of the RIs are located close to households, with a mean distance of 2.58km to their most preferred places of worship. It takes a median time of about 23 minutes to get to their respective RIs. As mentioned above, sometimes daily but mostly weekend attendance (Saturdays and Sundays) form a large part of household

[16] A location refers to an administrative unit in Kenya larger than a village and smaller than a ward.

participation in RIs. The weekly average attendance was approximately one. As households participate in RIs, there is also some interaction with religious leaders. A mean interaction level of about 17% is reported.

Regarding other contextual and other socio-economic characteristics, household heads have an average education level of about 8 years. Most households (74%) are male-headed households with a mean age of 45 years for household heads. Households have a mean size of about six members. About 65% of the households are married monogamously, while 12% are engaged in a polygamous form of matrimony. As the study area is a pastoral community, livestock keeping is very common, with households having a mean number of tropical livestock units of 3.18. They also report an average income of about 10,887.66Ksh and an accompanying asset level of 171,532.5Ksh.

4.6.2 Effect of RI on parental educational aspirations for children

Table 4.2 presents the relationship between participation in RI and parental educational aspirations for children. It also shows the parental aspirations for girls and boys separately. Across all the different specifications, we find a positive and statistical relationship between participation in RIs and parental aspirations for children. We see a positive and statistical relationship between participation in RIs and parental aspirations for children across all the various specifications. This finding is maintained when running separate regressions for girls and boys, though the results are not statistically significant in the case of parental aspirations for boys. Despite this non-significance, the positive coefficient of RI suggests that participation in RI can potentially improve the parental educational aspirations of their young boys. Participating in RIs increased parental

aspirations for children's education by up to 0.34 years of schooling. This is equivalent to an approximate increase in years of education by 2%. Estimating the average treatment effect on the treated (ATET), we obtain higher effects as can be seen in Table A17 in the supplementary file.

Table 4.2 Parental aspirations for children

	All Children		**Girls**		**Boys**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Religious	0.379**	0.339**	0.517**	0.459**	0.241	0.219
institution	(0.166)	(0.152)	(0.248)	(0.212)	(0.279)	(0.219)
% of PO	0.021**	0.018**	0.028**	0.025**	0.013	0.012
	(0.009)	(0.008)	(0.013)	(0.011)	(0.012)	(0.012)
Other controls	No	Yes	No	Yes	No	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of clusters	35	35	35	35	35	35
Observations	1060	1060	530	530	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, and ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household.

Regarding the parental aspirations for girls, we find that participating in a RI was associated with 0.46 higher parental educational aspirations than those that do not participate. This is an interesting finding and possibly indicates a 'girl effect' in educational aspirations (Bernard et al., 2019). Our results corroborate and agree with previous studies that find higher parental aspirations for girls than boys (Whetten et al., 2019; Zou et al., 2020). However, these results portray alternate conclusions from others that have found parental bias against female education aspirations (Bernard et al.,

2019; Dercon & Singh, 2013; Favara, 2017). A key difference seems to be the social nature of RI in uplifting the rights and positions of less privileged people, including women and girls. From the earlier days of Lutheran protestant expansion in medieval Europe, girls' education was highly encouraged (Becker, 2008), and this seemed to spread as Christianity extended into Africa (Kudo, 2017; Meier zu Selhausen, 2014). Our results are therefore consistent with religion's influence on girls' education and empowerment. Favara (2017) shows that gender bias in girls' education aspirations is associated with parental expectations in labour and marriage markets. Therefore, parents might believe that an educated daughter might have better chances in adulthood and aim to invest more in their educational attainment. There is, therefore, some suggestive evidence that participating in RI might be a pathway of narrowing gender biases, especially towards better outcomes for girls.

4.6.3 Effect of intensive religiosity on aspirations

Through a multivalued treatment effects estimator (Cattaneo, 2010; Cattaneo et al., 2013), we derive two estimates that assess the differences between high religiosity and low religiosity and between moderate religiosity and low religiosity.

Table 4.3 Religiosity and parental aspirations

	All Children	**Girls**	**Boys**
Medium religiosity	0.249	0.502	-0.003
	(0.221)	(0.327)	(0.295)
% of PO	0.013	0.027	-0.004
	(0.012)	(0.017)	(0.161)
High religiosity	1.034***	1.036***	1.032***
	(0.204)	(0.288)	(0.287)
% of PO	0.057***	0.058***	0.055***

	(0.011)	(0.016)	(0.016)
Other controls	Yes	No	Yes
Number of clusters	35	35	35
Observations	1060	530	530

Notes: Low religiosity is used as the benchmark for comparison. Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household.

The results of the multivalued treatment effect model are presented in Table 4.3. Using the low religiosity level as the control group, moving from low religiosity to medium religiosity increases parental aspirations for children, consistent with boys and girls separately, though the results are not statistically significant. However, households in the higher religiosity group have higher education aspirations, significant at the 1% level. This confirms the hypothesis that religiosity matters for aspirations but also varies with the extent of religiosity. The magnitudes are also similar in all the parental aspiration outcomes, showing that going from low religiosity to high religiosity increases parental aspirations for children by about 6%. The average treatment effect on the treated (ATET) is presented in Table A18 in the supplementary file.

4.6.4 Robustness checks and sensitivity analysis

To test the robustness of our results, we conduct three different checks. First, we follow Austin & Stuart (2017) to include non-linearity in the treatment selection model and re-estimate both the RI and religiosity models. In particular, we include square terms for age of the household head, years of schooling of the household head, TLUs, farm size and household size. Results in the supplementary material (Tables A19 and

A20) confirm that our estimates are robust and insensitive to non-linearity. Secondly, we assess our basic model using an alternative doubly robust estimator, the augmented inverse probability-weighting estimator. Results in the supplementary material Tables A21 and A22 show that our results are not driven by the choice of the weighting or matching estimator.

To further ensure the robustness of our estimates, we also performed some sensitivity checks to confirm the validity of the treatment effects estimated using the unconfoundedness assumption. This assumption states that after conditioning on a set of covariates, treatment outcome, in our case religiosity, is independent of potential outcomes. To render the credibility of our treatment effect estimates under this assumption, we follow Masten et al. (2020) to perform sensitivity inference on the treatment effect. This procedure relaxes the unconfoundedness assumption indexed by a conditional c-dependence scalar parameter $c \in [0,1]$ using non-parametric techniques. When $c = 0$, this is equivalent to the unconfoundedness assumption, and for $c > 0$, this assumption only partially holds, making it hard to learn the value of the treatment effect. In this case, only bounds that are usually a function of c can be extracted.

To estimate these bounds for different values of c, we use the *tesensitivity* package in Stata (Masten et al., 2020). This command estimates bounds on the treatment effect for a range of c-values. It also calculates a breakdown point: the maximum value of c under which the findings are maintained. This is analogous to r bounds in propensity score matching. We observe breakdown points at 0.012 for parental aspirations for children. This further confirms that the treatment effect is non-negative, as supported by our point estimates. The results are reported graphically in the supplementary file (Figures A2 and A3). Looking at the shape of the bounds, we see that our

data depict substantial robustness to relaxations of the baseline assumptions. Our estimated bounds are also small, showing strong data support of the robustness of our results to relaxations of unconfoundedness.

Furthermore, we perform some leave-out analysis where we estimate the 50^{th}, 75^{th} and 90^{th} percentiles. Inspecting the leave-out-variable-k propensity scores, we further observe that most variations are smaller than the treatment effect breakdown points, hence confirming the robustness of our results. These results are shown in Table A23 in the appendix.

4.7 Conclusion

This paper has examined the relationship between participation in RI and religiosity in general on parental educational aspirations for boys and girls in Kenya. We implement a doubly robust IPWRA estimator on both binary (RIs) and multivalued (religiosity) indicators to reduce selection bias. Overall, we find participation in RI to depict a positive and statistically significant effect on parental aspirations for children. Disaggregating by gender, we observe no significant relationship with the parental aspirations of boys but find a large and statistically significant impact for girls. These results are robust to changes in the choice of matching estimator used and introducing non-linearity in the treatment selection model. Further sensitivity tests show that our models are insensitive to confounding.

Suggestively, we believe that the correlations observed in this study are driven by religious role models and the potential of RI to look out for the less privileged. The role-model postulation is in line with previous studies that report a positive effect of role models on girls' aspirations (Beaman et al., 2012; Riley, 2018). The possible girl effect is further elevated by the

historical evidence of the impact of religion on female education and economic outcomes (Becker, 2008; Kudo, 2017; Meier zu Selhausen, 2014). We then consider a more subtle measurement of religious values and beliefs through a religiosity index. Comparing lower- and higher-religiosity households, we find that higher religiosity was associated with higher educational aspirations for all children. It is rather revealing that studies considering the role of religion find positive effects on girls' education while those assessing only the socioeconomic factors find a girl penalty. Studies from Ethiopia have found that parents have lower aspirations for girls and this is possibly driven by the general social perceptions of the role of women (Bernard et al., 2019; Favara, 2017). Our work therefore suggests that religion can be a transformative tool in both changing societal norms and in the advancement of educational achievements of girls.

In general, we make two key contributions that are relevant to development policy. First, we add to the literature in economics about the role of religion in development outcomes. We use refined and comprehensive measures of religiosity to show that religion and socio-economic outcomes are strongly related. Outcomes such as aspirations can be nudged through individuals' values and practices such as religion. Secondly, we contribute to recent studies on aspirations. While other studies have established that aspirations matter in development outcomes, we partly respond to the question of what drives aspirations. By moving beyond a binary measure of religious membership, we show that more intrinsic religious values and practices maintained with different intensities can predict aspirations. Adding to recent literature (Bloem, 2017; Bryan et al., 2020; Wydick et al., 2020), we show that religion can be a transformative contribution to development intervention especially through motivating internal constraints.

However, we are also cognizant of the possible negative role of religion in development (Rogers & Konieczny, 2018). In a study in the United States, Keister (2008) showed that conservative Protestantism was associated with lower levels of education and female labour-force participation and hence lower wealth accumulation. Using international cross-country data, Liu et al. (2018) also show that higher levels of religiosity predicted lower levels of national creativity. This evidence might not be directly related to individual aspirations but it suggests that not all religiosity is aspirational and transformational. While some aspects such as belief in hell or heaven predict higher economic growth, church attendance seems to reduce economic growth (Barro & McCleary, 2003). However, it is important to note that these studies are from high-income countries where the overall religious practice has declined over time (Brenner, 2016; Dogan, 2002). Our research might therefore not speak for these societies but rather for those in the Global South where religious practice is increasing (Tomalin, 2018).

Finally, our work is limited by two issues. First, since we used cross-sectional data, we are unable to derive causal results due to selection biases, especially from possible unobserved differences in the distribution of religious practices. While we employ tests for robustness and sensitivity, we can only control for observable differences. This leaves room for future research to build on this formative evidence to test more robust causal pathways. Moreover, in future, we will appreciate multi-disciplinary approaches since some of these questions have been studied in other disciplines such as sociology and anthropology, albeit not in causal ways. Secondly, despite basing some of our core arguments based on Weber's thesis, we were not able to separate the differences between religious groups such as Catholicism, Protestantism and the more recent Pentecostal Evangelicalism and even traditional African beliefs, due to data limitations.

Future research may want to delve more into this question and establish some interesting heterogeneity insights.

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4.9 Appendix

Table A14 Balancing diagnostics for membership in religious institutions

	Standardized differences		Variance ratio	
Variables	**Raw**	**Weighted**	**Raw**	**Weighted**
Age[a] (years)	-0.198	0.034	0.778	0.956
Years of education	0.347	-0.009	0.608	1.015
Head is male (1=yes)	-0.127	0.016	1.166	0.980
Household size	0.131	-0.037	0.820	0.824
Life satisfaction	-0.433	0.019	0.757	1.023
Number of dependents	0.051	-0.100	0.864	0.835
Access to electricity (1=yes)	0.175	-0.006	1.090	0.997
Cooperative membership (1=yes)	-0.058	0.012	0.933	1.015
Savings account (1=yes)	0.400	0.005	1.469	1.003
Farm size	0.070	0.036	0.648	0.771
Has a male child	0.066	-0.037	0.978	1.012
Has a female child	0.102	-0.019	0.985	1.003
Willingness to invest in agriculture (1=yes)	-0.214	0.057	0.754	1.094
Livestock ownership (TLU)	-0.069	-0.005	0.662	1.194
Household income (Ksh)	-0.074	0.032	0.414	0.914
Off farm income (Ksh)	-0.149	-0.001	0.535	1.643
Asset value (Ksh)	-0.024	0.020	0.190	0.406
Monogamous household (1=yes)	-0.222	0.033	0.877	0.978
Polygamous household (1=yes)	-0.222	0.030	0.622	1.074

Notes: The variables represented here are those used for weighting. Standardized differences are differences means for non-members and members of RIs after the means have been scaled by the average of the group variance. The variance ratio is the ratio of the

variance of the non-members of RIs over the variance of the members of RIs. 'Raw' refers to unmatched data while 'weighted' refers to data that has been weighted

Table A15 Factors predicting participation in religious institutions

Variables	**Coefficient**
Age[a] (years)	-0.006
	(0.005)
Years of education	0.498***
	(0.199)
Head is male (1=yes)	-0.430**
	(0.187)
Household size	0.089***
	(0.037)
Life satisfaction	-0.398***
	(0.100)
Number of dependents	-0.058
	(0.056)
Access to electricity (1=yes)	0.358***
	(0.146)
Cooperative membership (1=yes)	-0.220
	(0.160)
Savings account (1=yes)	0.413***
	(0.150)
Farm size	0.063
	(0.045)
Has a male child	-0.132
	(0.155)
Has a female child	-0.035
	(0.161)
Willingness to invest in agriculture (1=yes)	-0.365**
	(0.147)
Livestock ownership (TLU)	-0.020
	(0.015)
Household income (Ksh)	-0.006
	(0.004)
Off farm income (Ksh)	-0.011
	(0.007)

Asset value (Ksh)	-0.006
	(0.005)
Monogamous household (1=yes)	0.037
	(0.207)
Polygamous household (1=yes)	-0.472*
	(0.254)
Constant	2.250***
	(0.824)
Log likelihood	82.30
Pseudo R^2	0.127
Ethnicity dummies	Yes
Ward dummies	Yes
Village FE	Yes
Number of observations	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. The margins command is used in STATA to generate the marginal effects.

Table A16 Factors predicting religiosity

Variables	**Low religiosity**	**Medium Religiosity**	**High religiosity**
Age[a] (years)	0.015	-0.018*	-0.014
	(0.015)	(0.010)	(0.011)
Years of education	1.388***	0.375	-2.184***
	(0.553)	(0.426)	(0.627)
Head is male (1=yes)	0.174**	0.740**	-0.206
	(0.320)	(0.377)	(0.427)
Household size	0.116	0.105	-0.178***
	(0.074)	(0.082)	(0.064)
Life satisfaction	0.037	0.043	-0.353*
	(0.171)	(0.222)	(0.201)
Number of dependents	-0.170	-0.186	0.096
	(0.117)	(0.135)	(0.080)
Access to electricity	0.201	-0.717**	0.733***
(1=yes)	(0.343)	(0.307)	(0.239)
Cooperative	0.117	1.018***	-0.473*
membership (1=yes)	(0.355)	(0.377)	(0.270)

Savings account (1=yes)	1.013***	-0.038	1.049***
	(0.319)	(0.266)	(0.261)
Farm size	0.083	0.032	-0.118**
	(0.121)	(0.124)	(0.052)
Has a male child	-0.213	0.195	0.043
	(0.325)	(0.316)	(0.279)
Has a female child	0.124	0.655**	-0.357
	(0.439)	(0.350)	(0.257)
Willingness to invest in agriculture (1=yes)	0.605**	0.566	0.371
	(0.280)	(0.439)	(0.305)
Livestock ownership (TLU)	-0.009	-0.034	0.043**
	(0.031)	(0.032)	(0.022)
Household income (Ksh)	0.001	0.001	0.010
	(0.001)	(0.001)	(0.009)
Off farm income (Ksh)	-0.014**	0.002	0.001
	(0.008)	(0.002)	(0.009)
Asset value (Ksh)	0.002	0.003***	0.002***
	(0.001)	(0.009)	(0.004)
Monogamous household (1=yes)	-0.404	-0.765***	0.954**
	(0.318)	(0.438)	(0.474)
Polygamous household (1=yes)	0.239	-0.302	0.983**
	(0.392)	(0.597)	(0.501)
Constant	13.411***	16.219	21.322***
	(1.799)	(1.690)	(1.289)
Ethnicity dummies	Yes	Yes	Yes
Ward dummies	Yes	Yes	Yes
Village FE	Yes	Yes	Yes
Number of observations	177	177	176

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. The margins command is used in STATA to generate the marginal effects.

Table A17 ATET estimates for religious institutions

	All Children		Girls		Boys	
	(1)	(2)	(3)	(4)	(5)	(6)
Religious institution	0.413**	0.412**	0.524**	0.496**	0.303	0.328
	(0.166)	(0.160)	(0.249)	(0.222)	(0.221)	(0.229)
Other controls	No	Yes	No	Yes	No	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of clusters	35	35	35	35	35	35
Observations	1060	1060	530	530	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, and ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household.

Table A18 ATET estimates for religiosity

	All Children	Girls	Boys
Medium religiosity	0.127	0.323	-0.067
	(0.203)	(0.293)	(0.286)
High religiosity	1.274***	1.283***	1.263***
	(0.244)	(0.353)	(0.341)
PO mean of low religiosity	17.647***	17.588***	17.705***
	(0.159)	(0.241)	(0.217)
Village FE	Yes	Yes	Yes
Number of clusters	35	35	35
Observations	1060	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household. Both medium and high religiosity are computed based on the potential outcome (PO) mean of low religiosity.

Table A19 Robustness-Additivity and non-linearity for religious institutions

	All Children	**Girls**	**Boys**
Religious	0.62***	0.642**	0.603
institution	(0.239)	(0.337)	(0.334)
Other controls	Yes	No	Yes
Village FE	Yes	Yes	Yes
Number of clusters	35	35	35
Observations	1060	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, Interacts with religious leaders, livestock ownership, household income, off-farm income, asset value, monogamous household, polygamous household, and distance to RI. Some additional square terms of education, age, TLU, farm size and household size were added.

Table A20 Robustness-Additivity and non-linearity for religiosity

	All Children	**Girls**	**Boys**
Medium religiosity	0.188	0.438	-0.060
	(0.222)	(0.327)	(0.299)
High religiosity	0.972***	0.978***	0.966***
	(0.205)	(0.289)	(0.289)
PO mean of low religiosity	17.883***	17.839***	17.927***
	(0.136)	(0.199)	(0.190)
Village FE	Yes	Yes	Yes
Number of clusters	35	35	35
Observations	1060	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household. Some additional square terms of education, age, TLU, farm size

and household size were added.. Both medium and high religiosity are computed based on the potential outcome (PO) mean of low religiosity.

Table A21 AIPW Estimates for religious institution

	All Children		**Girls**		**Boys**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Religious institution	0.379** (0.166)	0.344** (0.152)	0.513** (0.248)	0.466** (0.210)	0.241 (0.223)	0.223 (0.216)
Other controls	No	Yes	No	Yes	No	Yes
Village FE	Yes	Yes	Yes	Yes	Yes	Yes
Number of clusters	35	35	35	35	35	35
Observations	1060	1060	530	530	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household.

Table A22 AIPW estimates for religiosity

	All Children	**Girls**	**Boys**
Medium religiosity	0.259	0.515	0.003
	(0.214)	(0.312)	(0.286)
High religiosity	1.021***	1.035***	1.007***
	(0.201)	(0.285)	(0.283)
PO mean of low religiosity	17.819***	17.765***	17.872***
	(0.133)	(0.196)	(0.217)
Village FE	Yes	Yes	Yes
Number of clusters	35	35	35
Observations	1060	530	530

Notes: Robust standard errors are reported in parentheses. *, **, and *** represent statistical significance at the 10%, 5%, and 1% levels, respectively. Other controls include life satisfaction, household size, age, years of education, Head is male, access to electricity, cooperative membership, has a savings account, farm size, ethnicity, has a male child, has a female child, number of children below 15, willingness to invest in agriculture, livestock ownership, household income, off-farm income, asset value, monogamous household, and polygamous household. Both medium and high religiosity are computed based on the potential outcome (PO) mean of low religiosity.

Table A23 Variation in leave-out-k propensity scares

	50th percentile	**75th percentile**	**90th percentile**
Age[a] (years)	0.011	0.022	0.034
Years of education	0.020	0.049	0.083
Head is male (1=yes)	0.016	0.037	0.076
Household size	0.025	0.051	0.081
Life satisfaction	0.056	0.086	0.130
Number of dependents	0.008	0.016	0.027
Access to electricity (1=yes)	0.035	0.056	0.074
Cooperative membership (1=yes)	0.012	0.025	0.041
Savings account (1=yes)	0.036	0.057	0.084
Farm size	0.001	0.002	0.003
Has a male child	0.011	0.019	0.029
Has a female child	0.005	0.009	0.014
Willingness to invest in agriculture (1=yes)	0.028	0.046	0.095
Interacts with religious leaders (1=yes)	0.004	0.007	0.016
Livestock ownership (TLU)	0.007	0.014	0.025
Household income (Ksh)	0.008	0.016	0.028
Off farm income (Ksh)	0.007	0.014	0.022
Asset value (Ksh)	0.002	0.004	0.008
Monogamous household (1=yes)	0.001	0.002	0.004
Polygamous household (1=yes)	0.014	0.034	0.067
Distance to RI (Km)	0.001	0.002	0.003

Figure A1 Distribution of propensity scores

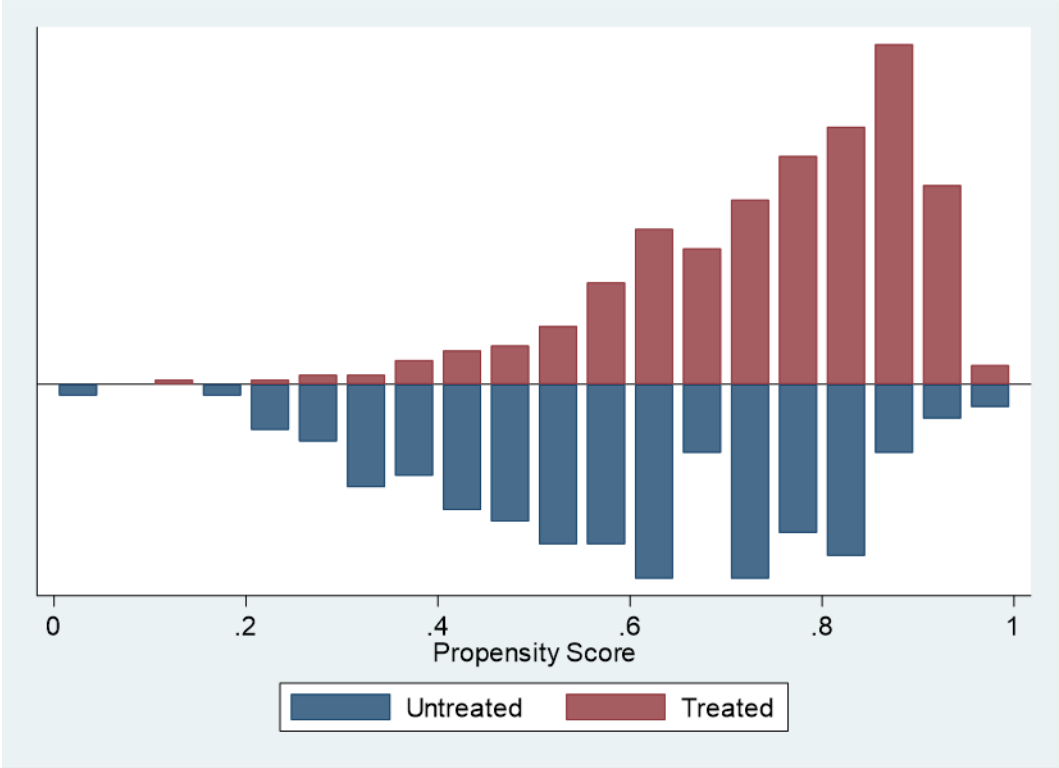


Figure A2 Bounds on treatment effects for girls

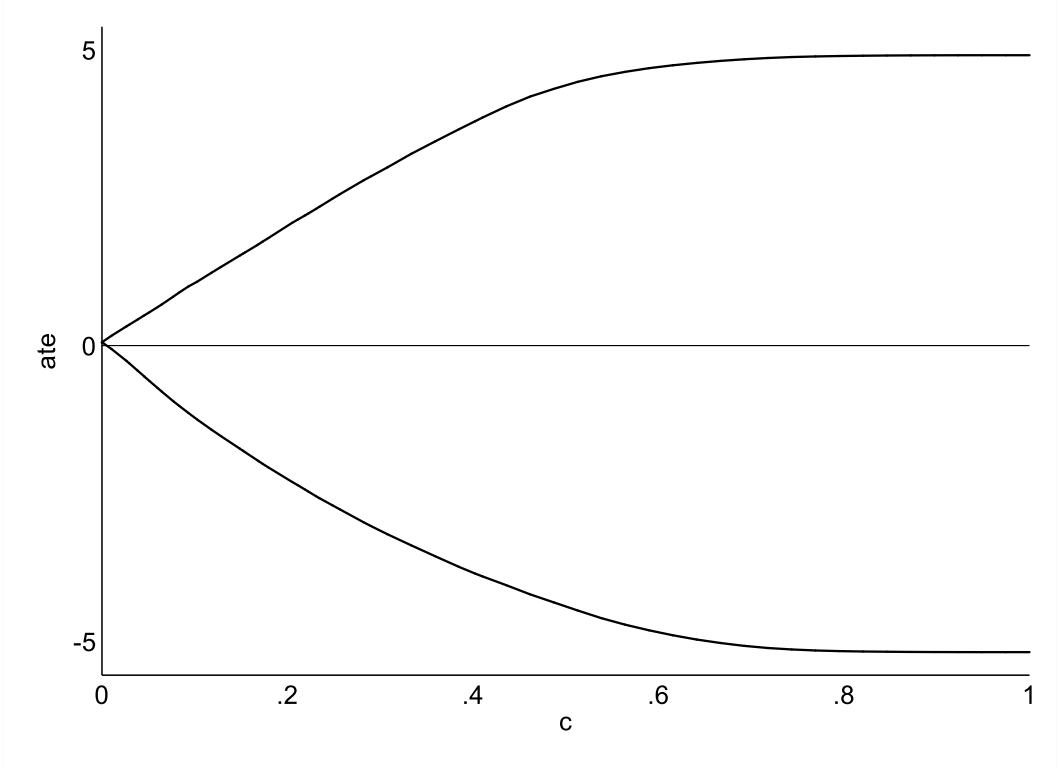
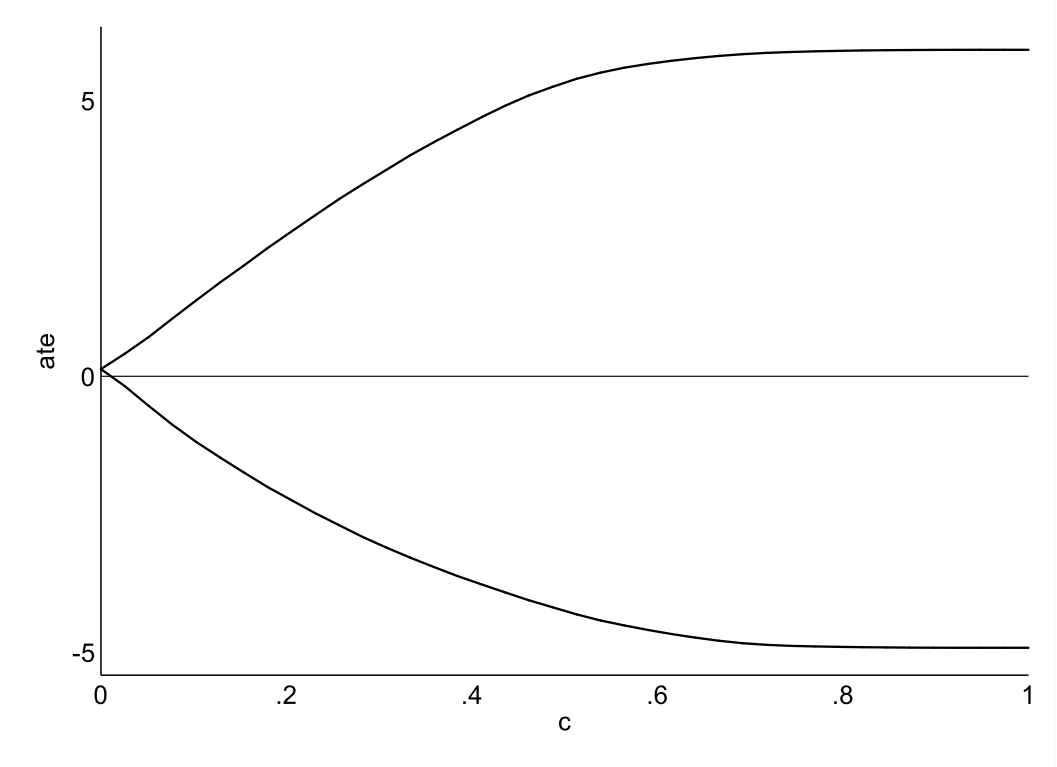


Figure A3 Bounds on treatment effects for boys



Chapter 5

Turning from Good to Bad: Aspirations and Livestock in Kenya[17]

Abstract

Aspirations have been shown to positively influence future-oriented behavior and ensuing outcomes. But they may also fail to do so when the aspired-to-status is too far away from the current one. Theoretical predictions suggest an inverted U-shaped relationship between this aspiration gap and the effort to achieve what is aspired to. Aspirations that are ahead but not too far ahead of the current status serve as the best incentives for investments. We examine the income aspiration gap of smallholder households and relate it to livestock in a pastoral setting in Northern Kenya. Our focus on livestock is guided by the burgeoning recognition of livestock as an investment and saving conduit for many households in pastoral communities in developing nations. Employing

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Author contributions: Tabe-Ojong, MP Jr.: conceptualization, data collection and curation, formal analysis, writing original draft; Heckelei, T: funding acquisition, writing - review and editing the paper; Sebastian, R: conceptualization, writing - review and editing the paper.

different empirical strategies including parametric and semi-parametric techniques, we find livestock to be increasing with aspirations up to a threshold, from which it then declines leading to an aspiration failure. Different U-shaped tests confirm this relationship, bolstering the evidence of an aspiration failure. To unpack which livestock matters more relative to the others, we perform some heterogeneity analysis and found cattle to respond most to the aspiration gap. The findings are robust to the inclusion of relevant controls, truncations at zero and different variable transformations. We also show that the findings are unlikely to be driven by unobserved heterogeneity. A dive into mechanisms reveals that the internal locus of control, i.e. the degree to which individuals believe they control outcomes in their lives, decreases with the aspiration gap. Our findings have two implications: first, it reinforces previous claims of the role of psychological constraints on poverty reduction and rural development. More importantly, it has implications for the current debates and plans for boosting the development of the livestock sector in Africa as a pathway to overall economic development.

Keywords: Aspirations; Investment; Livestock savings; Psychological constraints

JEL classification codes: D91, E71, I32, O13

5.1 Introduction

The poor usually make very little in the way of investments even in the face of high returns (Banerjee and Duflo, 2007). This behaviour has been attributed to external constraints like information asymmetry, poor infrastructure and access to education, missing markets and market imperfection in product and credit markets, as well as to inappropriate credit and saving measures (Banerjee and Newman, 1993; Dasgupta and Ray, 1986; Galor and Zeira, 1993; Janzen et al., 2017). While we recognize the relevance of the above factors in explaining an individual's failure to benefit from investments, external constraints may not explain satisfactorily the lack of future-oriented behaviour (Janzen et al., 2017). Internal constraints like agency and aspirations, which have largely been unexploited in the literature, may also have a role to play in explaining the partial lack of 'future making' of individuals (Banerjee and Mullainathan, 2010). This matches a quote that can be attributed to the early philosopher and economist Adam Smith, that 'the real tragedy of the poor is the poverty of their aspirations'.

Aspirations have been associated with various future-oriented socio-economic outcomes. Particularly, they are associated with human capital through education (Beaman et al., 2012; Bernard et al., 2019; Favara, 2017; García et al., 2019; Macours and Vakis, 2014; Pasquier-Doumer and Brandon, 2015; Ross, 2019; Serneels and Dercon, 2021), savings (Janzen et al., 2017; Seshan and Yang, 2014), and women's empowerment (Kosec et al., 2021). They also matter in inducing civic engagement and political participation (Healy et al., 2017; Kosec and Mo, 2017) and increasing happiness (Stutzer, 2004). Beyond the above relationships, aspirations also increase food security (Mekonnen and Gerber, 2017).

Since a positive relationship is suggested between aspirations and future-oriented efforts, and thus outcomes, one direct policy implication could be to boost aspirations. This is not straightforward however, as the theoretical literature highlights an inverted U-shaped relationship between aspiration and future-oriented economic efforts (Dalton et al., 2016; Genicot and Ray, 2017; Lybbert and Wydick, 2018). This goes to say that aspirations should be large enough to incentivize but not so large as to cause frustration, resulting from highly perceived unattainable efforts. In this regard, it is the aspiration gap rather than the aspiration that determines behaviour (Ray, 2006). The aspiration gap is defined as the difference between the individual's current and aspired-to status. The way individuals respond to this gap may lead to an aspiration failure in boosting the individual's future-oriented efforts. It thus becomes relevant to better understand the link between the aspiration gap and individual behaviour in a bid to uplift the poor from chronic poverty.

In this paper, we provide additional insights on the link between aspirations and future-oriented behaviour by testing the theorized non-monotonic inverted U-shaped relationship between income aspiration gap and livestock. Using household-level data from Kenya, we find evidence of an inverted U-shaped relationship between income aspiration gap and households' holdings of livestock, signalling evidence of aspiration failure in Kenya. Specifically, we find suggestive proof of 'aspiration fatalism' and 'aspiration frustration' arising from low and high aspirations respectively. Thus, we conclude that income aspirations that are ahead but not too far ahead of the current income levels offer the best incentives for increasing the livestock holdings of households. Our findings are robust to the inclusion of several controls, and various transformations of livestock including truncations at zero and the inverse hyperbolic sine transformation

(Bellemare and Wichman, 2019). We also show that one mechanism that could be driving the reduction in livestock holdings as a result of high aspirations is the reduction of the internal locus of control. This could be explained by frustration induced by high aspirations. In the interest of uncovering potential heterogeneities, we further reclassify livestock into three categories – large ruminants, small ruminants, and poultry – and find that large ruminants, particularly cattle, respond more to income aspirations.

We contribute to the literature on aspirations and future-oriented behaviour in four main ways. First, we add empirical evidence by directly testing the relationship between the aspiration gap and livestock holdings. The literature here is growing; however, it is mixed in terms of results (Bloem, 2021). While earlier analysis (Pasquier-Doumer and Brandon, 2015) reported no statistically significant relationship between aspirations and investments, recent studies show different results (Bloem, 2021; Janzen et al.,2017; McKenzie et al., 2021; Ross, 2019). McKenzie et al. (2021) even use experimental methods to exogenously induce financial aspirations as a means of credibly identifying the relationship between aspirations and financial decisions among poor entrepreneurs in the Philippines.

The second contribution relates to our outcome measure, livestock holdings. To our knowledge, this is the first study to examine the relationship between aspirations and livestock. In many arid and semi-arid regions in sub-Saharan Africa (SSA), livestock can be regarded as an encompassing measure of rural welfare as they serve to provide multiple services and products including nutritious food, insurance, wool (in the case of sheep) and traction power (Aryal and Holden, 2012). In Kenya for example, the Government with support from the Food and Agriculture Organization (FAO), the United States Agency for International Development (USAID) and other

stakeholders are working towards a sustainable livestock sector by 2050 in what is referred to as the African Sustainable Livestock 2050 Initiative (FAO, 2019). Cattle and poultry populations are projected to increase by about 94% and 375% respectively by 2050 (ibid). Beyond such national importance, livestock also signify and represent cultural values and attributes since they are offered for dowry and presented as gifts during weddings (Tabe-Ojong et al., 2021). Their droppings can also be used as organic fertilizers, with cattle and oxen even used as farm inputs for less mechanized farming systems (Veljanoska, 2021). Moreover, livestock are regarded as the bank of the poor as they allow for capital accumulation in the absence of access to banking and other viable means to save.

Third, we follow McKenzie et al. (2021) in eliciting a plausible mechanism through which aspirations that are difficult to achieve may have long-term effects on livestock holdings. This is through reducing the internal locus of control, which may make individuals believe that they do not have control over their lives. Such belief systems may have adverse effects on their future-oriented behaviour. This mechanism is additional and not included in the theoretical model of Genicot and Ray (2017). However, earlier work by Ross (2019) shows evidence of a positive association between high aspirations and low optimism and low agency, which relates to the belief systems of individuals. McKenzie et al. (2021) further show that failed or unmet aspirations may have enduring effects on financial investments through a reduction in the locus of control. Indeed if individuals with high aspirations believe that they have less control over outcomes in their lives, this may adversely affect their livestock holdings.

Our final contribution is on a regional scope, as we provide novel evidence of aspiration failure from SSA. To the best of our knowledge, there has been

no direct test of the aforementioned inverted U-shaped relationship in SSA. Most of the previous studies have been limited to Asian and South American countries like Nepal, Myanmar, India, Peru, Nicaragua, Colombia, Pakistan, and the Philippines.

To credibly identify the association between income aspirations and livestock savings, the use of experimental techniques may seem the best option (Bernard et al., 2019; McKenzie et al., 2021). However, ethical issues associated with the use of such techniques may render it less feasible. This is even more the case for this theorized relationship given that exogenously increasing aspirations in an experimental setting may render individuals worse off if this relationship is indeed true (La Ferrara, 2019). For instance, exogenously inducing higher financial aspirations amongst poor entrepreneurs in the Philippines led to potentially harmful outcomes like less borrowing, reduced business investments and an eroding internal locus of control (McKenzie et al., 2021). In this case, credibly identifying this relationship with the use of econometric methods suited for observational data (despite the limitations) may be the best way forward (Bloem, 2021). We include a plethora of controls in the regression models to account for potential confounding factors. However, it may be the case that unobservable factors may be driving the inverted U-shape, though it seems difficult to explain how unobservable factors may be doing so (Janzen et al., 2017). We employ the framework of Altonji et al. (2005) and Oster (2019) to verify how large the effect of unobservable factors would need to be, in comparison to the observable factors, to annul the inverted U-shaped relationship between income-aspiration gap and livestock holdings. Here, we find evidence that the inverted U-shaped relationship is robust to the influence of unobserved factors.

The rest of the paper is structured as follows: the theoretical framework presented in section 5.2 offers a brief overview of the relationship between aspirations and future-oriented behaviour, which is followed by a description of the research area and data used in the analysis. Section 5.4 provides information on the empirical model and the empirical strategies used. Results are presented and discussed in section 5.5 along with the various robustness checks, while the article concludes in section 5.6 with an outlook.

5.2 Theoretical framework

To structure thinking about aspiration failure and motivate testing the inverted U-shaped relationship between aspirations gap and livestock, we present a simple theoretical model. The framework we utilize is derived and discussed in Genicot and Ray (2017). It was later summarized by Janzen et al. (2017) with some minor modifications in Bloem (2021). For this analysis, we extend the model to the context of livestock savings in rural Kenya. We begin with what aspirations are, and move on to the concept of aspiration failure.

Aspirations are well-filtered goals and targets relevant from an individual's viewpoint and backed by motivational outcomes (Locke and Latham, 2002). They are targets that households set to achieve in the future. Being goals/targets for the future, they serve as motivators as households need to put in the necessary effort to achieve these aspirations. Investing efforts in achieving aspirations will only occur if the individual believes that these goals are achievable and that one has control over achieving these goals (Lybbert and Wydick, 2018). These efforts could take multiple forms including making productive investments and building up savings, which

may yield future returns and improved livelihoods. However, households might not invest the necessary efforts because of too high or too low aspirations, which would then be an aspiration failure.

Aspiration failure understood in the light of Appadurai (2004) results from a lower ‘capacity to aspire’. According to him, the poor get trapped in poverty because of a lower navigational capacity along social networks with sufficiently dispersed achievements of peers serving as aspirational targets, which could lead to small aspiration gaps. When the gap is small (aspiration is slightly above current achievement), the associated effort (investment) necessary to reach the aspiration is also low, causing no (or, at best, low) productive investment. Ray (2006) described this low investment to be an aspiration failure as it is a form of aspiration fatalism. As aspirations increase, the effort needed to achieve them goes up, and if individuals put in this additional effort, then aspirations fulfill their motivating role. However, there exists a point where higher aspirations lead to frustration since the required investment becomes too high. Thus, aspiration failure is a combination of both aspiration fatalism and aspiration frustration.

Understanding aspiration failure from a theoretical viewpoint is based on three grounded assertions (Dalton et al., 2016): (1) aspirations can be represented in utility functions as reference points that affect individual utility from any given outcome; (2) based on the feedback mechanism between efforts and aspirations through the realized outcome, aspirations and efforts are determined together in equilibrium. In short, low aspirations induce low efforts whose outcome reinforces low aspirations; (3) despite being determined jointly, individuals hardly incorporate the effort feedback on aspirations. This creates a bias in decision-making which may induce

aspiration failure. Such a decision-making process is termed behavioural, as an individual chooses his effort level while taking his aspiration as given.

According to the aspiration-based utility framework (Janzen et al., 2017), an individual with an initial wealth level (w_0) maximizes utility over the present and the future following a two-period utility function:

$$u(k,s) = v_0(k) + \beta[v_1(ps) + b \times I(ps \geq a)] \quad (1)$$

The individual can either use his income for consumption (*k*), or saving (*s*) purposes with an ensuing payoff (*p*). Rural Kenya being a pastoral community, livestock investments and savings are one of the forward-looking decisions of households. At the beginning of the first period, $w_0 = k + s$, while at the start of the second period $w_1 = ps$. In both periods, the individual derives utility from consumption and initial wealth. The individual also has aspirations *a,* which are assumed to be exogenous. Depending on whether the individual is meeting his aspirations, s/he also derives a 'bonus' utility, *b*, which can either be treated as an increasing function of how aspirations are exceeded (Genicot and Ray, 2017) or just as a constant amount gained (Janzen et al.,2017).[18] v_0 and v_1 are assumed to be smooth, increasing and strictly concave, while β is the discount factor.

Just like any other decision taken by households, benefits and costs of keeping livestock are being compared. The cost of these investments and savings can be represented as:

[18] This is done to maintain consistency with models that treat aspirations as reference points. Moreover, treating the 'bonus' utility as a constant amount if aspirations are met enables the marginal returns to consumption to have a similar difference above and below the aspiration threshold.

$$C(s) = v_0(w_0) - v_0(w_0 - s) \quad (2)$$

For the benefit function, the individual considers two alternatives. The first alternative is whether his/her aspirations are met, in which case it can be described as 'satisfied', or whether they are not met, which would imply 'aspiration frustration'. The benefit function is represented as:

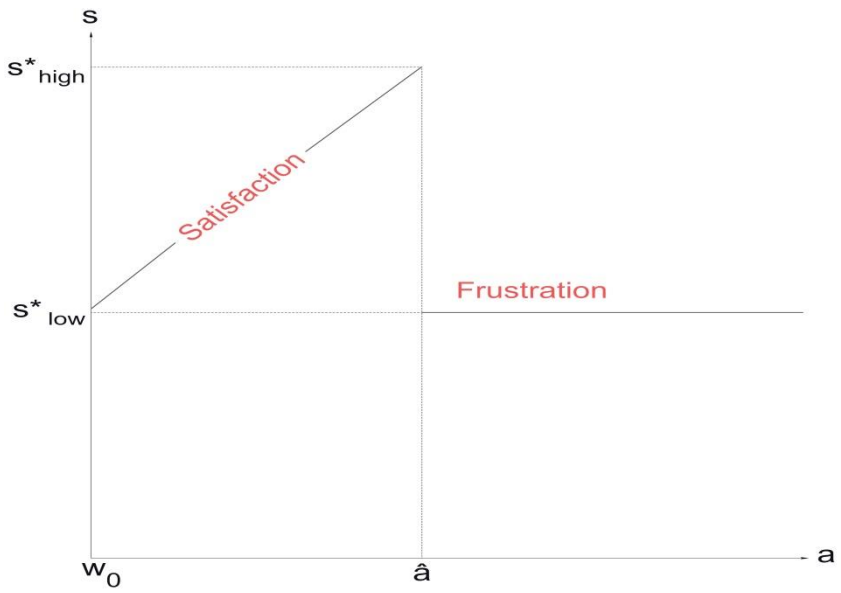
$$B(s) = \begin{cases} \beta[v_1(ps) + b] & \text{if } ps \geq a \text{ (satisfied)} \\ \beta[v_1(ps)] & \text{if } ps < a \text{ (frustrated)} \end{cases} \quad (3)$$

Following from this and in line with Genicot and Ray (2017), savings increase with aspirations up to a particular threshold $\hat{a}$ and declines because of the relative high aspiration-savings-investments required. In selecting a saving level, the individual compares the benefits, $B(s)$ and cost of the savings, $C(s)$ and will thus settle for an optimal savings level s^* that maximizes his/her net benefit of saving,

$$NB(s) = B(s) - C(s) \quad (4)$$

Based on the household's holding of livestock, s/he receives a return of ps on his/her investments and savings. Aspirations are satisfied when $ps \geq a$ and frustrated when $ps < a$ as illustrated in figure 5.1.

Figure 5.1 Savings and investments response to aspirations



From Figure 5.1, so far as the aspiration falls in the satisfaction zone, livestock increase with aspirations. However, after the aspiration threshold $\hat{a}$, there is a sharp change from satisfaction to frustration accompanied by a fall in the number of livestock. In this zone, savings and investments remain constant no matter the associated increase in aspiration since the cost of meeting aspirations $C(s)$ outweighs the benefits $B(s)$. Important to note that the chosen savings and investment range from s^*_{low} to s^*_{high}: s^*_{low} is optimal for an individual whose aspiration is above the threshold while levels slightly above s^*_{low} and s^*_{high} is optimal when aspirations are below the threshold. At the threshold $\hat{a}$, the individual is indifferent between satisfying his/her aspirations or not. This turning point depends on the wealth level of the individual as well as other characteristics associated with their utility function (Bloem, 2021). For instance, individuals with greater wealth levels will have a higher turning point (Janzen et al., 2017). This implies that they will be less likely to experience aspiration frustration.

5.3 Data and measurement of variables

5.3.1 Data

This analysis is based on household-level data of 530 smallholder households from Baringo county in the Northern parts of Kenya. The survey was conducted between July and August 2019 and relied on a two-stage sampling framework. With support from the Kenyan National Bureau of Statistics (KNBS), 35 villages were selected using probability proportional to size sampling. In these villages, and with the help of the village leaders, we were able to construct household lists of all households in the randomly selected villages. In the second step, we randomly selected 15-16 households from each selected village.

Interviews were then conducted with the household heads or their spouse. This process was carried out by a group of well-trained enumerators who interviewed households in their local languages. Interviews were enabled with the use of questionnaires designed on survey-based tablets. The questionnaires were concise, allowing households to report their aspirations based on 5 dimensions (Bernard and Taffesse, 2014). Information was also collected on the socio-economic characteristics of the households such as age, education and family size. Current wealth levels including livestock ownership and access to institutional services such as credit and extension as well as membership in producer organizations were also recorded. Table 5.1 presents the summary statistics of some of these variables.

Table 5.1 Summary statistics of model variables

	Mean	Std. Dev.
Outcome variables		
Livestock ownership (yes=1)	0.84	0.36
Herd size (number)	20.57	35.76
Herd size (TLU)	3.18	5.07
Covariates		
Income aspirations	45484.15	60869.41
Income-aspirations gap	0.69	0.19
Income-aspirations gap^2	0.52	0.24
Age of household head	45.15	15.62
Education level of the household head (years)	7.89	4.86
Household head is male (yes=1)	0.74	0.44
Household size	5.94	2.83
Access to credit (yes=1)	0.43	0.49
Extension contact (yes=1)	0.26	0.44
Cooperative membership (yes=1)	0.25	0.44
Off-farm income (yes=1)	0.27	0.44
Income (Ksh)	10887.65	13330.24
Asset ownership (Ksh)	171532.5	1055138
Tugen and Pokot ethnicity (yes=1)	0.66	0.47

Notes: Just about 13 households in the sample have a Pokot origin. Given that households with a Tugen ethnicity reported more livestock holdings than households from the Ilchamus ethnic group, we combined these 13 Pokot households with the Tugen households to create a dummy for ethnicity which reflects some pastoral underpinnings and keen attention to livestock keeping.

5.3.2 Measurement of aspiration gap

Different scales have been used to proxy and measure aspirations in many settings, making comparisons between studies non-trivial. We relied on direct aspiration measures using the framework of Bernard and Taffesse (2014). Based on specific dimensions, these measures have been at the core of recent aspiration studies (Bloem, 2021; Janzen et al.,2017; Kosec and Mo, 2017). With regards to income aspirations, we essentially asked

households four questions.[19] The first two were anchoring questions and the latter two were (1) 'what is your present level of income?' and (2) 'what level of income would you like to achieve in the future?' While (1) represents the current income level of households, (2) is the aspired-to income level.

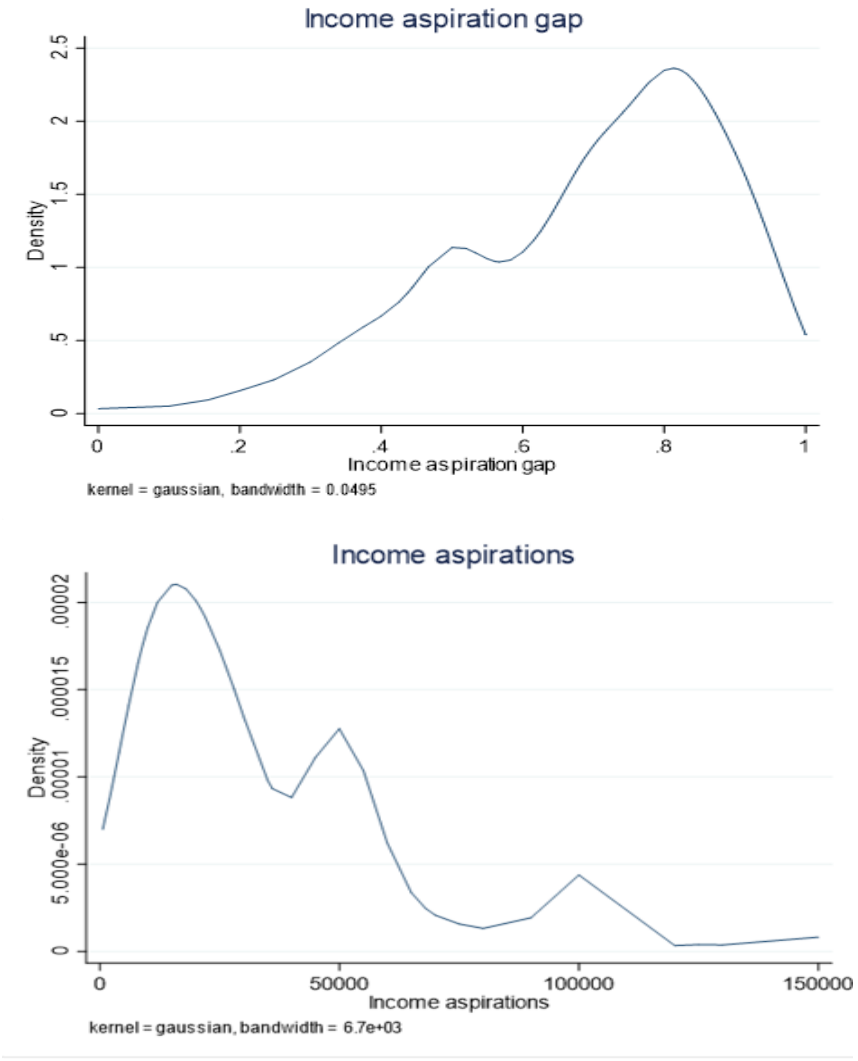
From the two measures above, we then computed the aspiration gap as the relative difference between current and aspired-to levels[20]:

$$Aspiration\ gap = \frac{aspiration - current\ status}{aspiration} \quad (5)$$

The measure ranges between 0 and 1, enabling comparison across households with different current status levels. For dimensions with a current status of zero and an aspired-to status greater than zero, the aspiration gap will be one. Figure 5.2 shows the distribution of income aspirations and income aspirations gaps. Income aspirations are quite variable. Aspirations are positively and aspiration gaps negatively skewed. Households have an average monthly income of 10,887Ksh[21] ($105) and an average monthly income aspiration of 45,484.15Ksh ($437), signalling that aspirations are about 4.5 times the current levels.

[19] The first two of the four questions are only used to get the respondents to settle for a realistic range for his/her aspirations. This relates to the enquiry about the maximum and minimum income levels of households in the local area of the household.
[20] This gap has also been used by Janzen et al.,2017; Ross, 2019 and Bloem, 2021
[21] 1Ksh= $0.0096 (06.07.2019)

Figure 5.2 Distribution of Income aspiration and aspiration gaps



5.3.3 Measurement of livestock savings

In rural Kenya, like in many semi-arid and arid regions of sub-Saharan Africa, livestock are a common means of investment and saving. In these regions, households usually keep livestock as a buffer for unforeseen events and to store the value. That is, apart from serving the purposes of food and farm production, livestock are also used for insurance and saving motives

(Abay and Jensen, 2020). We use three measures of livestock: (1) a binary measure of livestock holding. i.e. whether the household has any livestock or not. Livestock here refers to cattle, goats, sheep, rabbits, poultry and donkey. (2) the herd size as a head-count of all the livestock per household. While this contains more information than the binary measure, treating the different livestock as equal will still allow only a rather poor comparison of livestock value across households. We therefore also use (3) Tropical Livestock Units (TLU). TLU was developed by the Food and Agriculture Organization and essentially apportions units to different livestock based on their live weight. For instance, a cow equals 0.70 units, a sheep or a goat represent 0.1 units and a chicken equals 0.01 units.

5.4 Empirical strategy

Our empirical strategy involves estimating the relationship between income aspiration gaps and livestock by including a set of controls as explanatory variables shown in Eqn. (6):

We perform both parametric and semi-parametric methods to empirically test the inverse U-shaped relationship between aspirations and livestock investments. From a parametric point of view, our empirical strategy involves estimating the relationship between income aspiration gaps and livestock by imposing a quadratic functional form and including a set of controls as explanatory variables shown in Eqn. (6):

$$LS_{iv} = \beta_0 + \beta_1 G_{iv} + \beta_2 G_{iv}^2 + \beta_3 W_{\boldsymbol{iv}} + \beta_4 \boldsymbol{X_{iv}} + v_{iv} + \epsilon_{iv} \quad (6)$$

Where LS_{iv} represents livestock, G_{iv} the income aspiration gap and G_{iv}^2 allows the fitted relationship to exhibit the theorized non-monotonic

functional form between the income aspiration gap and livestock. $\boldsymbol{X_{iv}}$ is a vector of controls including socio-economic characteristics of households like age, education, sex, family size, institutional variables like access to credits, extension services and membership in cooperative groups. Here, we also control for the current wealth status of households as well as for their ethnicity. Controlling for the current wealth status (*W*) is important for two main reasons: (1) the wealth level of households is presumably correlated with livestock through other channels. Wealthier households may have more livestock than their counterparts. (2) The turning point of the aspiration gap effect on livestock could be increasing in one's current wealth level (Janzen et al., 2017). To cater for this possibility, we include an interaction between current wealth and the aspiration gap. We also control for village fixed effects (v_{iv}). ϵ_{iv} is the residual term and $\beta_0, \beta_1, \beta_2, \beta_3, \beta_4$ are the coefficients to be estimated. Our main parameters of interest are β_1 and β_2 since they tell us how and how strongly the aspiration gap incentivizes livestock savings.

For an inverse U-shaped relationship to be confirmed, we expect the slope of the curve to be positive ($\beta_1 > 0$) when G = 0 and negative ($\beta_1 + 2\beta_2 < 0$) when G = 1 with one turning point between. Just looking at the signs of β_1 and β_2 may be enough to already comment on the presence of the inverted U-shaped relationship. However, as Lind and Mehlum (2010) have argued, this might be sound but potentially misleading[22]. We thus follow the framework they adopted in testing and confirming the presence of a U-shaped relationship following tests developed by Sasabuchi (1980). The test

[22] As they highlight, it becomes problematic when the true relationship is convex but monotone over different data values. In this case, a quadratic specification may erroneously yield an extreme point. In such cases, it may be worthwhile to test whether the relationship is increasing and decreasing at high and low values respectively within the interval.

provides results for the estimated slopes at G=0 and G=1, the turning point, the Sasabuchi p-value and the Fieller confidence interval for the turning point.

For a robustness check, we also employ semi-parametric techniques where we do not impose any prior functional form for how the aspiration gap enters the equation:

$$LS_{iv} = \beta_0 + f(G) + \beta_3 W_{iv} + \beta_4 \boldsymbol{X_{iv}} + v_{iv} + \epsilon_{iv} \quad (7)$$

The only difference between equations (6) and (7) is how the gap enters the estimation.

The following additional analyses are performed: (1) In the interest of unpacking heterogeneity as to which type of livestock matters more, we also disaggregate livestock into large ruminants, small ruminants and poultry. (2) We also explore the mechanism that the locus of control could be partially driving the relationship between aspirations and livestock. (3) Given that our results could still be driven by unobserved heterogeneity despite the inclusion of various controls, we estimated bounds based on Altonji et al. (2005) and Oster (2019), indicating how large the omitted variable bias has to be to annul the estimated relationship between aspirations and livestock. (4) We finally perform some robustness checks applying variable transformations, including truncations at zero and the inverse hyperbolic sine transformation (Bellemare and Wichman, 2019).

5.5 Results and discussion

5.5.1 Evidence of aspiration failure

We use OLS to estimate our models both for the continuous and the dichotomous livestock savings outcomes. For the dichotomous outcome, we used the linear probability model, for which we also estimated probit models for robustness. Beginning with the dichotomous measure of livestock ownership, we observe consistency with the inverse U-shaped relationship between income aspirations and livestock savings, though the relationship is not statistically significant (Table 5.2). The sign of the income aspiration gap is positive while the sign of the squared income aspiration gap is negative. Given that we aggregated all livestock irrespective of the live weight, it is probable that we missed out on some relevant heterogeneity. To unpack the underlying reasons, we perform some disaggregation analysis in the next section.

Table 5.2 Estimates of the association between aspirations gap and livestock ownership (binary measures)

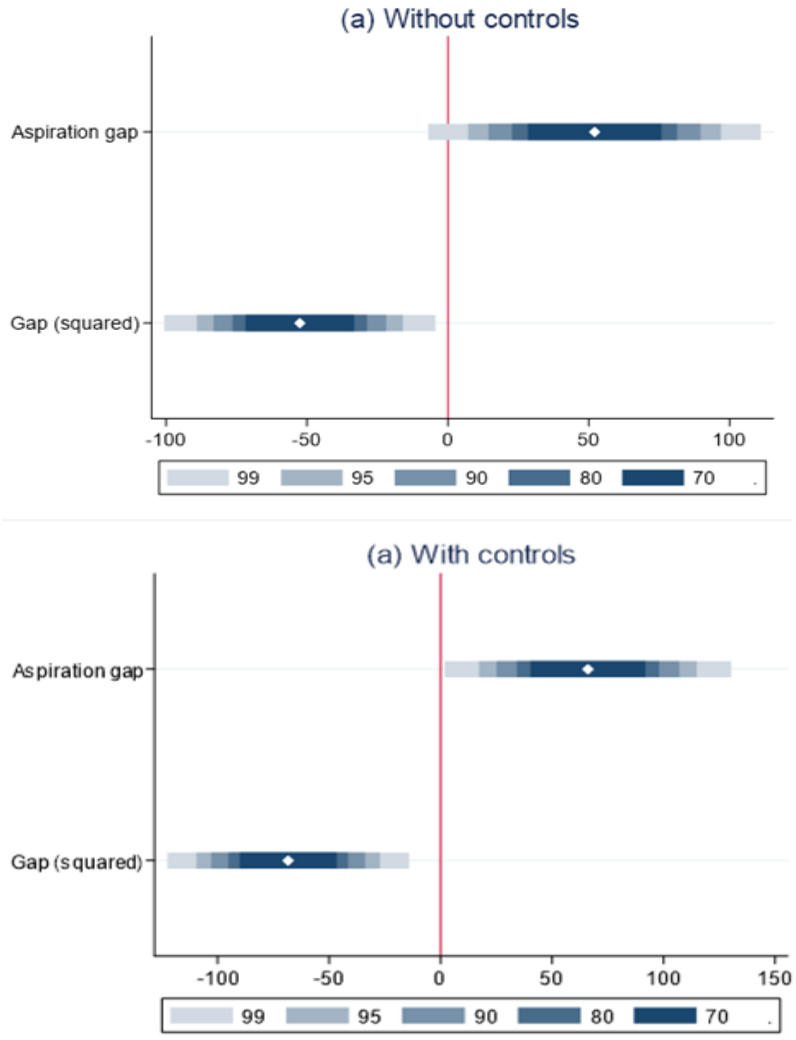
	LPM		**Probit**	
	(1)	**(2)**	**(3)**	**(4)**
Income-aspirations gap	0.330	0.148	0.201	0.005
	(0.442)	(0.435)	(0.459)	(0.410)
Income-aspirations gap^2	-0.405	-0.209	-0.334	-0.117
	(0.361)	(0.354)	(0.356)	(0.320)
R squared	0.169	0.245	0.016	0.122
Village FE	Yes	Yes	No	No
Additional controls	No	Yes	No	Yes
F statistic	3.37***	3.10***		
Observations	530	530	530	530
U-test results				
Turning point	0.408	0.355	0.300	0.321
Sasabuchi p-value	0.366	0.366	0.331	0.495

Slope at minimum	0.330	0.148	0.840	0.026
Slope at maximum	-0.479	-0.270	-1.954	-1.186
Fieller 95% confidence interval	[-Inf; +Inf]	[-Inf; +Inf]	[-Inf; +Inf]	[-Inf; +Inf]

Notes: In columns (2) and (4), we include additional control variables. Additional controls include the age of the household head, educational level of the household head, gender of the household head, household size, access to credit, extension contact, cooperative membership, off-farm income, wealth levels, and ethnicity. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Moving to the continuous measures of livestock saving (Figure 5.3), we considered both the herd size and the standard TLU. For both measures, we estimated two models where we controlled for different confounding (Table 5.3). In models (2) and (4), we include a set of controls to establish the robustness of our model to observed heterogeneity. The estimated coefficients of the gap are very similar. Because of this similarity, we have decided to discuss models (2) and (4). Looking at both the herd size and the TLU, we observe a positive relationship between the income-aspirations gap and livestock. As expected, an inverse relationship is reported for the square of income-aspiration gap and livestock. The coefficient estimates here are statistically different from zero. Looking specifically into this relationship, a one-percent increase in the gap before the turning point leads to an increase in livestock by about 53 herds. In terms of livestock units, about 7.3 TLUs is saved. Given that our two measures of livestock savings offer similar signs and direction, our results are robust to continuous measures of livestock holdings. Overall, the findings are in line with the theoretical predictions that aspirations that are ahead but not too far ahead of the status quo serve as the best incentives for household savings and investments.

Figure 5.3 Relationship between aspiration gap and livestock



The U test results (Table 5.3) further support the evidence of this inverted U-shaped relationship. The Sasabuchi p-values are below 0.05, allowing us to reject the hypothesis that the first derivative of the quadratic fit is the same sign at both the maximum and minimum points of the interval. We estimate a turning point around 0.49, similar to turning points reported in Janzen et al. (2017) and Bloem (2021). The Fieller 95% confidence interval (CI), which simply gives the CI around the turning point of the U-shaped

function (Fieller, 1954), lies within the interval of the argument. All these results act as additional support for the inverted U-shaped relationship.

Table 5.3 Estimates of the association between aspirations gap and livestock ownership (Herd size and TLU)

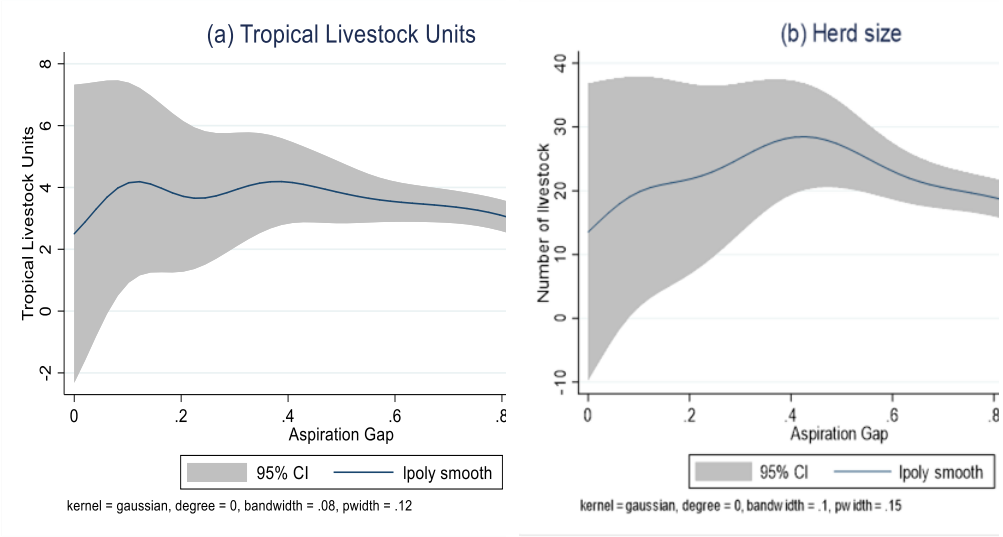
	Herd size		**TLU**	
	(1)	**(2)**	**(3)**	**(4)**
Income-aspirations gap	66.088***	52.028**	9.117*	7.334*
	(24.858)	(22.817)	(5.129)	(4.326)
Income-aspirations gap^2	-66.345***	-52.552***	-9.637**	-7.642**
	(20.962)	(18.597)	(3.960)	(3.367)
R squared	0.124	0.294	0.113	0.311
Village FE	Yes	Yes	Yes	Yes
Additional controls	No	Yes	No	Yes
F statistic	2.94***	3.39***	2.77***	3.96***
Observations	530	530	530	530
U-test results				
Turning point	0.483	0.495	0.473	0.479
Sasabuchi p-value	0.004	0.011	0.038	0.045
Slope at minimum	66.088	52.028	9.117	7.334
Slope at maximum	-70.595	-53.071	-3.180	-7.949
Fieller 95% confidence interval	[0.276;0.602]	[0.197;0.618]	[0.237;0.601]	[0.516;0.612]

Notes: In columns (2) and (4), we include additional control variables. Additional controls include the age of the household head, educational level of the household head, gender of the household head, household size, access to credit, extension contact, cooperative

membership, off-farm income, wealth levels, and ethnicity. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

We now check if the inverted U-shape relationship holds if we apply semi-parametric techniques. As shown in Figure 5.4 (a and b), the results are again indicative of the theorized relationship between aspirations and investments. Conclusively, the theorized inverse relationship between aspiration and livestock is maintained both when imposing and when not imposing a functional form on the relationship.

Figure 5.4 Non-parametric relationship of aspiration and livestock investments



Our results suggest the presence of both aspiration fatalism and aspiration frustration for pastoralists in Kenya. Small income-aspiration gaps are associated with little in the way of livestock savings. In such cases, aspirations are unmet, since they are small and probably internalize little effort. However, for individuals whose aspirations are far ahead of their

current status, their livestock savings increase with aspirations up to a turning point beyond which the required savings level may be very high, resulting in resignation and frustration. Our results lend credence to previous studies that have tested and confirmed this theorized relationship (Bloem, 2021; Janzen et al.,2017; McKenzie et al., 2021; Ross, 2019).

5.5.2 Aspiration-gap effect statistically only holds for cattle in disaggregated analysis

As outlined in section one, livestock serve multiple purposes in rural areas including precautionary savings and insurance, market-related purposes, use in farm production and in signalling social status. Because of this, households may decide to own particular livestock based on their expected perceived benefits. While some households who are exposed to the vagaries of weather may prefer investing in small ruminants such as sheep and goats which can be liquidated easily (Abay and Jensen, 2020), others may prefer a larger stock such as cattle as they represent higher savings, with more milk and manure production (Shackleton et al., 2005) as well as greater status. We thus reclassify and disaggregate livestock ownership into three separate groups of large ruminants (cattle), small ruminants and poultry to untangle the livestock savings and relate this to the income aspiration gaps of households. Given that all the outcomes are binary, we again used the linear probability model for estimation. As shown in Table 5.4, the expected signs and direction of the estimated coefficients speak to the theoretical predictions. However, only cattle ownership is statistically significant. This offers an interesting insight into livestock heterogeneity. Cattle seem to matter more in response to aspirations than other livestock. High but not too high aspiration levels would induce households to invest in large ruminants as opposed to small ruminants and poultry. This finding can be explained by social status as well as other inherent benefits like more meat, greater

manure production and higher savings which could be used to cushion or smooth consumption in times of income shocks. In terms of income aspiration, cattle are the relevant asset available for investing in future income streams and livelihood insurance.

Table 5.4 Income aspirations and livestock portfolio classification

	Cattle	Goat and sheep	Poultry
Income-aspirations gap	0.905*	0.590	0.194
	(0.535)	(0.749)	(0.539)
Income-aspirations gap^2	-0.864**	-0.623	-0.379
	(0.426)	(0.597)	(0.430)
R squared	0.275	0.265	0.232
Village FE	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes
F statistic	4.08***	3.89***	3.25***
Observations	530	530	530
U-test results			
Turning point	0.523	0.473	0.25
Sasabuchi p-value	0.045	0.215	0.360
Slope at minimum	0.905	0.590	0.194
Slope at maximum	-0.824	-0.655	-0.565
Fieller 95% confidence interval	[-2.492;0.649]	[-Inf; +Inf]	[-Inf; +Inf]

Notes: Additional controls include the age of the household head, educational level of the household head, gender of the household head, household size, access to credit, extension contact, cooperative membership, off-farm income, wealth levels, and ethnicity. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.5.3 Unobserved selection

Credibly identifying the relationship between income aspirations and livestock savings may require the use of experimental or panel data methods to control for both observed and unobserved heterogeneity. To reduce the

bias arising from our use of cross-sectional data, we test the robustness of our estimates first with the inclusion of a battery of control variables to reduce the potential bias of observable characteristics. Given that unobservable characteristics may jointly determine both income aspirations and livestock savings, we estimate by how much unobserved characteristics, in comparison with observed characteristics, can explain away the estimated inverted U-shaped relationship. For this, we followed the methodology proposed by Altonji et al. (2005) and Oster (2019).[23]

We used two approaches to do this: in the first approach, we assume a value for R^2 max and compute the value of delta for which beta is zero. This tells us how much greater the influence of unobservable factors would need to be, relative to observable factors, to let the inverted U-shaped relationship vanish (Oster, 2019). The second approach is to use bounds on R^2 max and delta to calculate bounds for beta. This indicates how our main estimates would change if selection on unobservables was as strong as the selection on observables. The estimated beta here can be described as bias-adjusted. For the first approach, we estimate that unobserved selection would have to be about six times[24] stronger than observed selection to explain away the inverted-U shaped relationship (Table 5.5). All of the values are outside the recommended 0-1 range (Oster, 2019). If the selection was equal, we observe bias-adjusted betas to be slightly above the estimated betas. The beta values fall within a 95% CI of the true estimated beta values. Thus, we

[23] The caveat in using these methods is that they rely on a set of assumptions which are untestable (Ross 2019). However, they do provide evidence as to what extent the model is influenced by omitted variable bias.

[24] A negative delta means that if the observables are positively correlated with the outcome, the unobservables have to be negatively correlated with the outcome to get the specified beta.

could conclude that the bias-adjusted betas are just an upper bound of the estimated betas since they don't change the original findings. Overall, we can conclude that the estimated inverse U-shaped relationship between income aspirations and livestock savings is not driven by potential unobserved heterogeneity.

Table 5.5 Check for omitted variable bias

	Income aspiration gap		**Income aspiration gap^2**	
	(1)	**(2)**	**(3)**	**(4)**
Beta	0	55.31	0	-54.63
Delta	6.07	1	-6.86	1
R^2 max	0.29	0.29	0.29	0.29
Observations	530	530	530	530

Notes: The estimated coefficients are set to zero and the degree of omitted variable bias is calculated in specifications (1) and (3). For (2) and (4), we follow Oster (2019) to set the omitted variable bias to be equal to selection on included controls. We then estimate the resulting bias-adjusted beta coefficient.

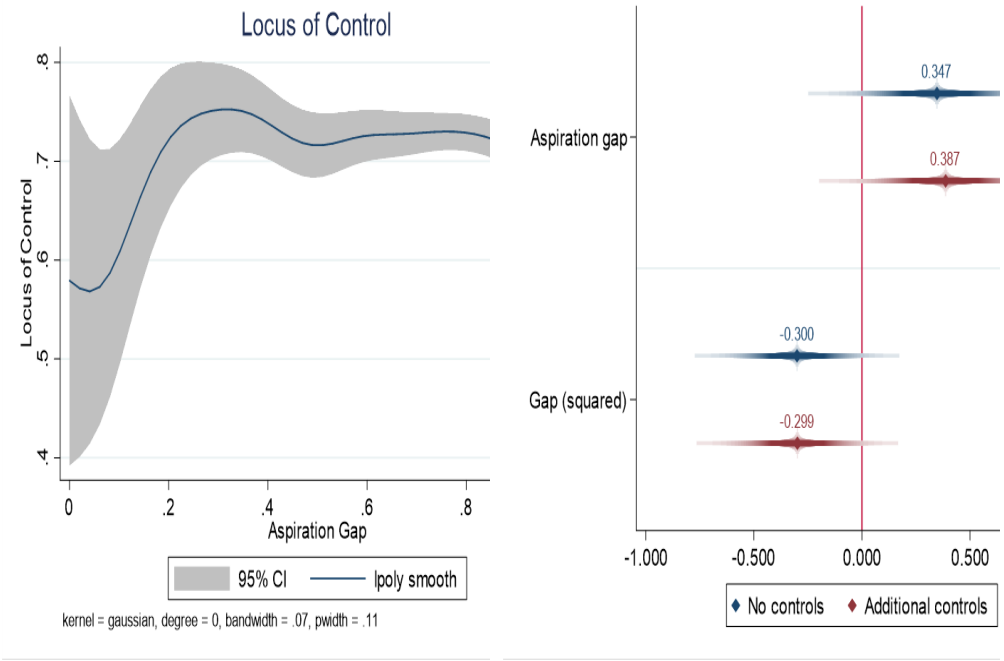
5.5.4 Aspiration gap and locus of control

According to Bernard et al. (2014), other aspiration studies have taken an indirect approach by measuring proxies for aspirations like locus of control. However, in the context of the aspiration gap, the concept of locus of control can be interpreted as a *mechanism* explaining reduced investments in the presence of high aspirations. Locus of control, understood as the belief that one has control over one's life (Rotter, 1966), reduces with increasing aspirations beyond a certain point as the individual does not believe him/herself to be able to achieve such lofty goals. Such reduction in beliefs may make people less willing to invest (McKenzie et al., 2021). While this is not theoretically motivated in Genicot and Ray (2017, 2020), we follow Ross (2019) and McKenzie et al. (2021) in using one measure of belief/control over one's life to establish if this is driving livestock reduction. To capture locus of control, we used 8 statements from the Rotter

(1966) scale and created a locus of control index. Higher scores represent an internal locus of control while lower scores signify an external locus of control. While individuals with an internal locus of control believe that they have control over life's outcomes, individuals with an external locus of control rather believe factors beyond their control and stochastic errors shape their lives.

Figure 5.5 shows some positive correlation between the aspiration gap and the locus of control. However, as the gap increases, a negative correlation is observed, with aspirations that are too high leading to a large aspiration gap (quadratic term). The semi-parametric technique further confirms this relationship. This result suggests large aspiration gaps correspond to a low extent to which households believe they have control over their lives. In this case, this may result in livestock reductions as they feel themselves to be at the mercy of external forces potentially interfering with efforts. While aspirations are goals that individuals seek to achieve, a reduction in the extent to which they believe they control outcomes about their lives may lead to frustration if aspirations stay unmet. Similar findings were observed by McKenzie et al. (2021) in the framework of exogenously inducing in the framework of exogenously inducing aspirations to entrepreneurs in the Philippines.

Figure 5.5 Relationship between aspiration gap and locus of control



5.5.5 Additional Robustness checks

In addition to verifying whether our results are driven by the inclusion of control variables and unobservable variables, we perform two additional checks. In the first, we conduct two transformations on the continuous livestock investment variable to efficiently manage zeros. Given that livestock holdings may follow a right-skewed distribution, our objective here is to express this in a manageable way. We truncate and exclude all households with no livestock to verify if our results are robust to the exclusion of zeros. As a second robustness check, we transform our outcome variable in such a way that the zeros, representing no livestock savings, are retained. We used the inverse hyperbolic sine (IHS) transformation (Bellemare and Wichman, 2019) as another means of

effectively managing zeros. Akin to natural log transformation, this transformation has the additional advantage of being able to handle and retain zeros. Estimating the models using OLS (Table 5.6), the coefficients are similar to the main model in signs, direction and magnitudes. The U-test results are also maintained, and further support the original findings. The findings confirm that our model is not sensitive to the exclusion of zeros or to the IHS transformation. This further strengthens the empirical evidence supporting the hypothesis that aspirations that are ahead but not too far ahead of the status quo incentivize households to undertake productive investments and savings that can improve their welfare and livelihood options.

Table 5.6 Estimates when truncating and retaining zeros in livestock ownership

	Flock size		**TLU**	
	Truncated	**IHS**	**Truncated**	**IHS**
Income-aspirations gap	69.067***	2.668**	10.340**	2.675***
	(27.185)	(1.481)	(5.087)	(1.008)
Income-aspirations gap^2	-68.105***	-2.504**	-10.127**	-2.511***
	(22.248)	(1.238)	(4.026)	(0.805)
R squared	0.288	0.313	0.303	0.351
Village FE	Yes	Yes	Yes	Yes
Additional controls	Yes	Yes	Yes	Yes
F statistic	2.73***	6.75***	3.28***	8.56***
Observations	433	530	433	530
U-test results				
Turning point	0.507	0.532	0.510	0.532
Sasabuchi p-	0.005	0.036	0.021	0.004

value				
Slope at minimum	69.067	2.668	10.340	2.675
Slope at maximum	-67.136	-2.341	-9.913	-2.347
Fieller 95% confidence interval	[0.285;0.614]	[0.375;0.691]	[0.068;0.627]	[0.347;0.612]

Notes: Additional controls include the age of the household head, educational level of the household head, gender of the household head, household size, access to credit, extension contact, cooperative membership, off-farm income, wealth levels, and ethnicity. Robust standard errors clustered at the village level are in parentheses. *** p<0.01, ** p<0.05, * p<0.1

5.6 Conclusion

In this paper, we examine the specific relationship between aspirations and future-oriented outcomes. Particularly, we provide an empirical test of the theorized non-monotonic relationship between the aspiration gap and efforts. We define the income-aspiration gap to be the difference between the current income status and the aspired-to income status of households relative to the aspiration level. For our measures of efforts, we focus on livestock savings and investments which is arguably an important indicator of rural welfare, especially in many pastoral communities in developing nations. Here, we consider the various livestock owned by households, proxied as the herd size as well as Tropical Livestock units (TLUs). We relate these outcomes to the income-aspiration gap and establish whether aspirations that are ahead, but not very far ahead of people's current status serve as incentives for livestock savings. Using household-level data from 530 smallholder households in Northern Kenya, we find aspirations to increase livestock savings. However, we also note that very high aspirations relative to the current status lead to lower livestock savings. This could be explained by frustration arising from the fact that a high level of livestock

savings is necessary to match up with such high aspirations. This is explained by a reduction in the internal locus of control which reflects the reduced belief of being in control of one's life, thought to be a prerequisite for engaging in the effort to achieve desired goals.

Using various tests, we find evidence of an inverted U-shaped relationship between aspirations and livestock savings in Kenya. The findings are also robust to the inclusion of additional controls, truncations of livestock savings at zero and the inverse hyperbolic sine transformation, which efficiently retains zeros. We also show that it is very unlikely that our findings are driven by omitted-variable bias. Performing some heterogeneity analysis, we find that the aspiration gap responds more to investments in large ruminants like cattle as opposed to small ruminants like sheep and goats. In addition to previous findings, our study brings forward two new insights. To begin with, we strengthen the theoretical (Genicot and Ray, 2017) and empirical debates (Bloem, 2021; Janzen et al., 2017; McKenzie et al., 2021; Ross, 2019) that psychological and behavioural factors like aspirations matter for improving future-oriented outcomes, especially in terms of investments and savings. Solely focusing on improving development outcomes by relieving and relaxing external constraints may not be effective if the aspirations of households are not considered. But again, only fostering aspirations may yield similar unsatisfactory outcomes given that the aspiration gap is a function of the current wealth levels. In this regard, the two should be regarded as complements rather than as exclusive in reducing rural poverty and achieving shared prosperity.

Finally, we reinforce the role of other psychological and internal factors like locus of control in fully explaining this non-linear relationship between aspirations and future-oriented behaviour. Taken together, the analysis has

implications for pastoral communities in many rural areas. At a time when many governments in Africa are galvanizing efforts with support from organizations like USAID and FAO to boost livestock production in the framework of the Africa Sustainable Livestock 2050 initiative, our findings show aspirations to be one of the conduits for this great transformation. That said, improving aspirations should be highly caveated given that high aspirations could just lead to frustration and reduced investments (McKenzie et al., 2021). In this regard, simply exposing households to the relevant networks and successful households in their communities may bring about the apposite ways of improving their aspirations, leading to increased investments (Beaman et al., 2012; Bernard et al., 2019).

We end by highlighting some limitations of the study which point to the need for future research. Given that we use cross-sectional data, we cannot fully claim to have controlled for all confounding factors that may be in the way of establishing causality in the inverted U-shaped relationship. That said, although our analysis can be argued to plausibly have implications for many pastoral settings in Africa where livestock ownership represents rural wealth to a great extent, we encourage future work along these lines to strengthen the external validity of these findings. Building upon the relationship between the locus of control as a mechanism explaining the inverted U-shaped hypothesis and doing so theoretically may be of immense interest in the growing aspirations literature.

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5.8 Appendix

Table A24 Estimates of the association between aspirations gap and livestock ownership (binary measures) - full results

	LPM		Probit	
	(1)	**(2)**	**(3)**	**(4)**
Income-aspirations gap	0.330	0.148	0.201	0.005
	(0.442)	(0.435)	(0.459)	(0.410)
Income-aspirations gap^2	-0.405	-0.209	-0.334	-0.117
	(0.361)	(0.354)	(0.356)	(0.320)
Age of household head		0.002**		0.002*
		(0.001)		(0.001)
Education level of the household head (years)		-0.001		-0.003
		(0.004)		(0.004)
Household head is male (yes=1)		0.014		0.018
		(0.040)		(0.035)
Household size		0.028***		0.035***
		(0.005)		(0.006)
Access to credit (yes=1)		0.036		0.022
		(0.032)		(0.035)
Extension contact (yes=1)		-0.014		-0.027
		(0.035)		(0.036)
Cooperative membership (yes=1)		0.107***		0.147***
		(0.035)		(0.043)
Off-farm income (Ksh)		-0.032		-0.058
		(0.040)		(0.037)
Income (Ksh)		0.859**		0.098
		(3.251)		(0.052)
Asset ownership (Ksh)		0.013*		0.002
		(0.007		(0.001)
Tugen and Pokot ethnicity (yes=1)		0.099		0.126
		(0.100)		(0.079)
Constant	0.780***	0.421**		
	(0.167)	(0.184)		

R squared	0.169	0.245	0.016	0.122
Village FE	Yes	Yes	No	No
Additional controls	No	Yes	No	Yes
F statistic	3.37***	3.10***		
Observations	530	530	530	530
U-test results				
Turning point	0.408	0.355	0.300	0.321
Sasabuchi p-value	0.366	0.366	0.331	0.495
Slope at minimum	0.330	0.148	0.840	0.026
Slope at maximum	-0.479	-0.270	-1.954	-1.186
Fieller 95% confidence interval	[-Inf; +Inf]	[-Inf; +Inf]	[-Inf; +Inf]	[-Inf; +Inf]

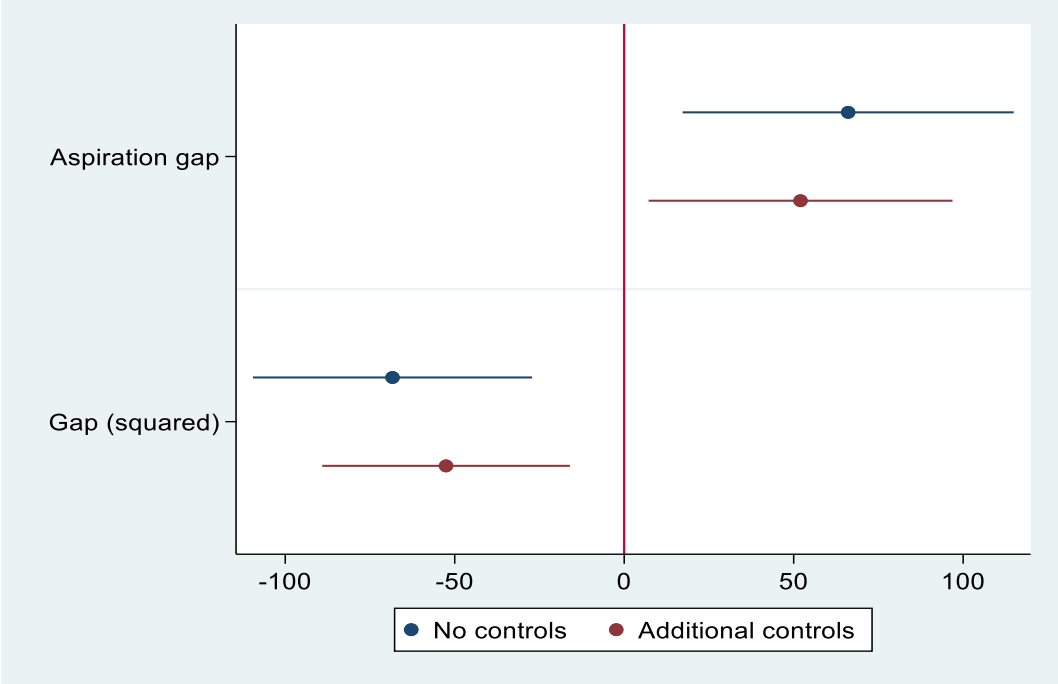
Table A25 Estimates of the association between aspirations gap and livestock ownership (Herd size and TLU) – full results

	Flock size		**TLU**	
	(1)	**(2)**	**(3)**	**(4)**
Income-aspirations gap	66.088***	52.028**	9.117*	7.334*
	(24.858)	(22.817)	(5.129)	(4.326)
Income-aspirations gap^2	-66.345***	-52.552***	-9.637**	-7.642**
	(20.962)	(18.597)	(3.960)	(3.367)
Age of household head		0.488***		0.075***
		(0.135)		(0.018)
Education level of the household head (years)		1.210***		0.178***
		(0.387)		(0.063)
Household head is male (yes=1)		5.619***		3.264**
		(2.072)		(1.235)
Household		0.068		0.227***

size		(0.517)		(0.079)
Access to credit (yes=1)		-0.127 (2.322)		-0.175 (0.411)
Extension contact (yes=1)		1.793 (2.569)		0.415 (0.423)
Cooperative membership (yes=1)		10.993*** (5.089)		2.110*** (0.699)
Off-farm income (Ksh)		1.120 (3.063)		-0.650* (0.374)
Income(Ksh)		0.265** (2.135)		0.025 (0.036)
Asset ownership (Ksh)		1.151*** (0.363)		0.016** (0.049)
Tugen and Pokot ethnicity (yes=1)		-1.727 (6.277)		-0.352 (1.164)
Constant	2.160 (8.778)	-37.837*** (11.986)	0.730 (1.761)	-6.482 (1.822)
R squared	0.124	0.294	0.113	0.311
Village FE	Yes	Yes	Yes	Yes
Additional controls	No	Yes	No	Yes
F statistic	2.94***	3.39***	2.77***	3.96***
Observations	530	530	530	530
U-test results				
Turning point	0.483	0.495	0.473	0.479
Sasabuchi p-value	0.004	0.011	0.038	0.045
Slope at minimum	66.088	52.028	9.117	7.334

Slope at maximum	-70.595	-53.071	-3.180	-7.949
Fieller 95% confidence interval	[0.276;0.602]	[0.197;0.618]	[0.237;0.601]	[0.516;0.612]

Figure A4 Relationship between aspirations and livestock



Chapter 6

Coping with COVID-19 in rural Africa: An analysis of household-level coping strategies in response to food insecurity in Kenya, Namibia, and Tanzania[25]

Abstract

COVID-19 threatens to counteract many efforts aimed at achieving food and nutritional security across Africa. This paper documents the extent of COVID-19-related food insecurity in Kenya, Tanzania and Namibia. Using the Household Food Insecurity Access Scale, we measured food insecurity along various dimensions and documented several food-access disruptions

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Author contributions: Tabe-Ojong, MP Jr.: conceptualization, formal analysis, writing original draft, data collection and curation, Funding Acquisition, writing - review and editing the paper; Gebrekidan, B: conceptualization, formal analysis, data collection and curation, Funding Acquisition, writing - review and editing the paper; Nshakira-Rukundo, E: conceptualization, formal analysis, data collection and curation, Funding Acquisition, writing - review and editing the paper; Börner, J: writing - review and editing the paper; Heckelei, T: writing - review and editing the paper.

that happened during mid-2020, a period during which many African countries implemented their first COVID-19 control policies. Furthermore, we assessed the association of COVID-19 with the utilization of various strategies in line with the Coping Strategies Index. Using a unique phone survey that followed households from an earlier survey, and employing a multivariate probit regression model we report heterogeneity in the use of different household-level strategies against food access disruptions in the different countries as well as differential constraints. Households typically use strategies including reduced food intake, diversification of food sources towards less nutritious foods, intensifying food procurement, and drawing on support from the government and their peers. We provide evidence on the complementarities as well as synergies in the use of these options. Overall, households significantly reduced their food intake and relied on less nutritious foods supporting earlier claims that the COVID-19 pandemic has deleterious effects on food and nutrition security.

Keywords: COVID-19; food access; rural households; Kenya, Tanzania, Namibia

JEL classification codes: Z12, Z13, D83, D91, C83

6.1 Introduction

In early 2020, the COVID-19 pandemic spread to almost all parts of the world, affecting nearly all social and economic sectors. Food systems in developing countries suffered far-reaching effects, such as food-supply-chain disruptions (Laborde et al., 2020; Workie et al., 2020) and drops in food-production due to limitations in access to agriculture inputs (Ayanlade and Radeny, 2020; Elleby et al., 2020; Pu and Zhong, 2020). With projections that the virus would spread through international travel, especially air transport from China (Gilbert et al., 2020), countries responded initially by imposing international travel restrictions followed by national lockdowns, curfews and other movement restrictions. Additionally, within-country preventive measures included limiting and later stopping public gatherings and local market activities, enforcing social distancing and wearing masks. While these measures reduced disease spread and mortality in regions where they were effectively implemented (Chaudhry et al., 2020; Haider et al., 2020; Maier and Brockmann, 2020), they also had negative impacts on economies and food insecurity (Hamadani et al., 2020).

COVID-19 confronts several African countries with one of the most challenging food-insecurity situations (Rahaman et al., 2020). In this paper, we use three dimensions of food insecurity in selected rural regions of three African countries, namely; Tanzania, Kenya and Namibia. Firstly, we assess the extent of food insecurity during COVID-19 times. Secondly, we assess the level of COVID-19-related food-access disruptions such as increasing prices, inability to travel to markets and limited availability of food. Finally, we assess which coping mechanisms were used, and how households combine various coping mechanisms in the face of COVID-19-related food insecurity. We utilize a 2019 baseline survey conducted in the three

countries and augment it with a follow-up phone survey conducted during the time when Kenya and Namibia were under lockdown restrictions. Due to differences in COVID-19 response policies, we can show the extent of COVID-19 food insecurity across our regions of study.

First, we document the level of food insecurity in the three rural regions of Kenya, Namibia and Tanzania, revealing that over 42% of our sample went without food for at least a day in the previous 30 days and that over 70% were worried that their food might run out sooner and they might not have the resources to procure food. Second, we highlight food-access disruptions and disruptions in agricultural activities related to COVID-19 prevention actions. We find that the most common disruption was increased food prices. Finally, we show the various coping mechanisms that households employ in response to food insecurity. Through a multivariate probit model, we show the associations between COVID-19 shock various household-level coping strategies to food-access disruptions.

Households typically use strategies including reducing food intake, diversifying food sources towards less nutritious foods, intensifying food search, receiving government and humanitarian support and receiving help from family and peers We explore the interdependencies in the use of these strategies, revealing complementarities and substitutabilities. We find that, for instance, households who reduce food intake also increase food search and rely more on less nutritious foods.

The rest of the paper proceeds as follows: in Section 6.2, we present the general literature on COVID-19 and household food security. Section 6.3 provides the data and methods. Section 6.4 shows the descriptive and

empirical results. The concluding Section 6.5 provides a brief discussion and policy implications of this paper.

6.2 Related Literature: COVID-19, Household Poverty and Food Security

As of the 1st of August 2021, there have been 6.74 million recorded cases and 171,000 deaths from COVID in Africa (Hasell et al., 2020). As the third wave sets in, the pandemic will have had a huge negative effect on many economic sectors across the globe (Lawson-Lartego and Cohen, 2020). Recent studies suggest that falling living standards (Egger et al. 2021; Josephson et al., 2021), increasing poverty (Sumner et al., 2020) and general economic recession will affect low-income countries in particular (IMF, 2020; World Bank, 2020). As the crisis continues to unfold, there will be increased fears and risks to food security for most African states. Food insecurity manifests itself through disruptions in domestic food-supply chains, loss of income and reduced remittances, all limiting the capacity to purchase food (Cardwell and Ghazalian, 2020; Hobbs, 2020; Laborde et al., 2020; Pu and Zhong, 2020; Savary et al., 2020). Moreover, due to the restrictions in the movement of people and goods, food producers are expected to lose large amounts of easily perishable and nutritious foods (Arouna et al., 2020; Harris et al., 2020; Heck et al., 2020; Lal, 2020).

The literature on COVID-19 and food insecurity is growing[26] (Arouna et al., 2020; Barrett, 2020; Hobbs, 2020; Laborde et al., 2020; Lawson-Lartego & Cohen, 2020; Pu & Zhong, 2020; Savary et al., 2020). Ceballos et al. (2020)

[26] For instance a Web of Science search with the key search words "COVID-19" AND "food insecurity OR food security" covering 2020 and 2021 up to 2nd August 2021 produced 527 results.

show how pre-existing infrastructure in two Indian States mitigated market disruptions. These market disruptions culminate in farmers ending up in worse-off positions. COVID-19 has disrupted not only food markets but also the overall national and international supply chains (Aday and Aday, 2020; Ayanlade and Radeny, 2020; Cao et al., 2020; Elleby et al., 2020; Mahajan and Tomar, 2020), including access to agricultural inputs such as fertilizers and other inputs (Ayanlade and Radeny, 2020; Nchanji et al., 2021; Pan et al., 2020; Pu and Zhong, 2020).

Related to market disruptions, preventive measures equally created employment shocks through employment losses. Evidence from across low- and middle-income countries shows overall income losses due to stay-at-home policies (Bottan et al., 2020; Ceballos et al., 2020; Hamadani et al., 2020; Kansiime et al., 2021; Mahmud and Riley, 2021).

Using nationally representative phone-based surveys in Mali, Adjognon et al. (2021) report high levels of food insecurity, especially in urban areas. In Nigeria, food insecurity and labour-market participation was also found to be associated with COVID-19 cases and some containment measures like lockdowns (Amare et al., 2021) and the share of food-insecure households increased by 47% (Abay et al., 2021b). Effects are generally larger for poorer households and those living in remote and conflicted zones. Similar insights were also obtained in Kenya and Uganda (Kansiime et al., 2021). In some instances, social protection programmes have provided some level of protection from the adverse effects of the pandemic (Abay et al., 2021a; Bottan et al., 2020; Brum and Rosa, 2021). However, such programmes usually exhibit limited coverage.

While the literature on the havoc COVID-19 has caused regarding food security in low-income countries continues to grow, very limited research exists on how rural households are coping with this shock and how different coping mechanisms complement each other.[27] This paper therefore attempts to contribute to filling this gap in the literature by not only highlighting the coping mechanisms employed by rural households in Kenya, Tanzania and Namibia but also by exploring their interactions and complementarities. We offer insights into how the impacts of the pandemic have materialized across different geographies (semi-arid pastoral communities in Baringo County, Kenya; settled agricultural communities in Kilombero valley in Tanzania and settled semi-arid communities in Zambezi region in Namibia). Such insights will have implications on the development of different policy responses in buffering pandemic-related food insecurity.

6.3 Data and Methods

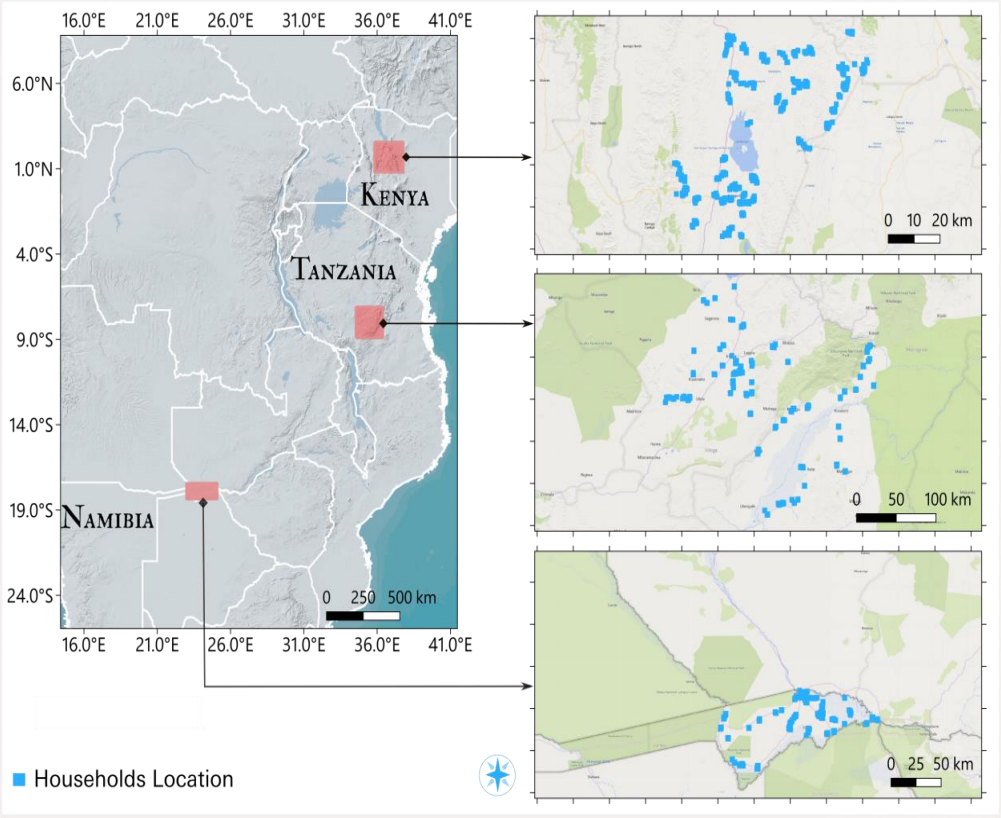
6.3.1 Household survey and COVID-19 follow-up phone survey

Our data come from a phone survey conducted in the Zambezi region in Namibia, Morogoro and Iringa regions (Kilombero valley) in Tanzania and Baringo County in Kenya. The phone survey followed up on an in-field baseline survey conducted with rural households between May and August 2019 under the Collaborative Research Centre – Future Rural Africa (henceforth CRC baseline). Following a stratified random sampling, the CRC baseline was conducted in 47 enumeration areas in Baringo, Kenya; 45 enumeration areas in Zambezi, Namibia and 60 enumeration areas in Tanzania. In all the countries, enumeration areas were based on the most

[27] A Web of Science search with the key search words "COVID-19" AND "food insecurity OR food security" AND "coping mechanisms" covering 2020 and 2021 up to 2nd August 2021 produced only 3 results.

recent population and housing census sampling frames. The CRC baseline survey comprised 871 households in Tanzania, 652 households in Namibia and 704 households in Kenya.

Figure 6.1 Map of study locations



During the CRC baseline survey, we asked households about mobile phone ownership. Mobile phone ownership was 70% in Kenya (494/ 704 households), 83% in Namibia (532/652 households) and 83% in Tanzania (723/871 households), making 1,749 households our prospective sample. Before the phone survey, we updated our phone ownership data with additional phone ownership information provided by village leaders. The prospective sample then increased to 737 households in Tanzania (84.6% of

the baseline), 666 households in Kenya (94.5% of baseline) and did not change in Namibia. Our prospective sample was therefore 1,935 households.

Previous studies have found lower mobile-phone ownership rates. For instance, mobile-phone ownership was 67.5% in Zambezi Namibia in 2016 (NSI, 2017), 35% in Baringo Kenya in 2019 (KNBS, 2019), and around 62.4% in Morogoro and Iringa regions in Tanzania in 2015 (MOHCDGEC, 2016). Our sample has higher phone ownership levels most likely, because mobile phone increases fast such that even a couple of years make a big difference. Moreover, it is plausible that in previous surveys households are likely to under-report phone ownership when it is used as an asset proxy. Moreover, in both the CRC baseline and the COVID phone survey, we provided households with an incentive equivalent to US$ 1 of phone credit; therefore, households might have reported higher/true phone ownership due to this incentive. Our prospective sample was 1,935 households, of which data was collected from 91.2% (1,764 households). Slightly over 2% were not reached, and 6.6% did not provide consent. Compared to average response rates of 50% in other follow-up surveys (Himelein et al., 2020), our survey was successful in tracking respondents.

Table 6.1 Phone survey sample

	Prospective sample	**Not reached**	**No consent**	**Collected sample**
Tanzania	737	0	57	680
Kenya	666	2	10	654
Namibia	532	39	61	430
Total	1,935	41	128	1,764

The phone survey collected information on household socio-demographics, food security and health-access measurements related to COVID-19, labour markets and work-related disruptions as well as social support and assistance among others. Critical for our purpose, information was also collected on the various measures households were using in coping with food insecurity. Data were collected in June and July 2020. This was approximately two months into local and international restrictions in Kenya and Namibia. Though Tanzania relaxed restrictions early on and stopped recording COVID-19 cases altogether in mid-May, our data capture the March to July timeline, partly inclusive of when restrictions were in place. However, to some extent, Tanzania provides a comparison as a place where stringent restrictions were not enforced, local markets not extensively curtailed and movements not prohibited. We therefore expect food insecurity to be worse in other countries compared to Tanzania.

Our empirical analysis is informed by two assumptions. First, we assume that coping measures employed by households might depend on the pre-COVID-19 levels of welfare. Less poor households, those with more land and less exposure to shocks in previous periods are more likely to be resilient and less food-insecure due to COVID-19 than those of limited means. We therefore include several pre-COVID-19 controls from the baseline survey, though our assessment remains at the cross-sectional level. Secondly, we assume that while the COVID-19 shock is to an extent a covariate shock, it can have substantial differences in exposure based on how at (health) risk or how (economically) vulnerable a household is. Therefore, to intuitively measure COVID-19 shock exposure, we asked respondents ‘On a scale of 1-5, how much effect has Coronavirus and related containment measures like lockdowns and curfews had on your general life?’ The Likert-scale response ranged from 1=very bad/negative

effect to 5=very good/positive effect. We then created a shock-exposure dummy from the Likert scale information. Thus, our measure does not directly capture the effect of COVID-19 but rather the effect of COVID-19 through its shadow effect via various measures and policies to contain it.

To measure food insecurity, we use the Household Food Insecurity Access Scale (HFIAS) (Coates et al., 2007), a widely used tool in food security and nutrition studies. The HFIAS measures, among others, feelings of uncertainty or anxiety over food (situation, resources, or supply), perceptions of food insufficiency (in both amount and quality/ nutritional diversity) and reductions of food intake. In particular, because of the necessity to keep the phone survey short, we use three out of the nine generic questions to capture food access and anxiety, and measure only the prevalence (yes/no) and not severity or frequency. Another measure of food insecurity is food-access disruptions. To capture this, we simply asked if households had had any challenges/disruptions in accessing the food they wanted in the previous 30 days. We then asked respondents what disruptions they experienced. Respondents were able to select multiple responses from four options. To measure coping strategies, we use the coping strategies index (Maxwell & Caldwell, 2008). To keep the questionnaire lean, we picked one (out of one) coping strategy to represent dietary change, two (out of four) strategies to represent short-term strategies and one (out of five) to represent rationing strategies. Since during COVID-19 many governments provided food relief, we include food relief as an additional option that is not in the coping strategies index list.

6.3.2 Empirical Specification

Respondents could select multiple responses from a list of five responses plus 'did nothing'. Exploring the driving factors behind utilizing and combining each of the five strategies is the basis of our empirical analysis. Since households used one or a combination of strategies, our empirical approach should be able to take into account the interdependency between the strategies. We thus use a multivariate probit (MVP) model in form of a conditional mixed process estimator (Cappellari and Jenkins, 2003) to control for this correlation between the use of the various strategies. The model further helps us to establish synergies, interdependences and trade-offs amongst the various strategies.

The decision to rely on and use a particular food-disruption strategy depends on an unobservable latent variable (household's utility), which is determined by observable variables such as age, gender, educational level, level of food disruption, social networks, food storage and availability, market access and shocks faced by the household. The higher the expected utility, the more likely it is for a particular strategy to be used. Despite our inability to observe the latent variable (Y_{im}^{*}) for each of the strategies used by households, we can quantify this decision as a binary variable (Y_{im}) and use the MVP model, as shown below:

$$Y_{im}^{*} = [\delta_{m}' X_{im} + \boldsymbol{\partial_{m}' Z_{im}} + \varepsilon_{im}]; m = 1,2,3,4,5 \quad (1)$$

$Y_{im} = 1$ if Y_{im}^{*}>0 and 0 otherwise

ε_{im} m=1,…., 5 are error terms distributed as multivariate normal, with a mean of 0 and a variance-covariance matrix **V,** where **V** has values of 1 on the leading diagonal and correlations $\rho_{jk=}\ \rho_{kj}$ as off-diagonal elements.

The MVP model generates an error term correlation matrix which is very informative about the interdependency between the use of the various strategies against food disruption. While a positive correlation between the error terms of the management options is indicative of complementarities or synergies, a negative correlation suggests substitutabilities or trade-offs between the strategies. This is presented and discussed in the results section.

X_{im} represents the COVID-19 shock. Z_{im} is a vector of control variables thought to be associated with the use of strategy m for household i while δ'_m and $\boldsymbol{\partial'_m}$ are vectors of parameters to be estimated. We used the Geweke-Hajivassiliou-Keane (GHK) smooth recursive conditioning simulator where a likelihood contribution is calculated for each replication and then averaged for all the replications. The simulated likelihood function is then maximized for the whole sample. This simulator utilizes a multivariate normal distribution function which can be expressed as a product of sequentially conditioned univariate normal distribution functions.

6.3.3 Outcome Variables

Our analysis covers three main outcomes, namely (1) food access disruptions, (2) food insecurity and (3) coping mechanisms to food insecurity. Food access disruptions are barriers to food access that might not have existed without COVID-19 restrictions and which are structurally correlated with COVID-19 restrictions. We therefore asked respondents this question: *"Have you experienced any disruptions in accessing food for your household in the last 60 days due to COVID restrictions?"* with a yes/no response. Households whose response was yes were then asked if they had experienced either or all of (1) limited availability of desired food in the markets, (2) increased prices, (3) inability to travel to markets and (4) other

disruption. These food access disruptions are likely caused by disruptions on local supply chains and market operations (Harris et al., 2020).

Secondly, we measured food insecurity. To measure food insecurity, we use the Household Food Insecurity Access Scale (HFIAS) (Coates et al., 2007), a widely used tool in food security and nutrition studies. The HFIAS measures among others, feelings of uncertainty or anxiety over food (situation, resources, or supply), perceptions of food insufficiency (in both amount and quality/ nutritional diversity) and reductions of food intake. Our measures of food insecurity were also consistent with other COVID-19-related food insecurity studies (Amare et al., 2021). Due to the necessity to keep the phone survey short, we use three out of the nine generic questions to capture food access and anxiety and measure only the prevalence (yes/no) and not severity or frequency.

Finally, to measure coping strategies, we use the coping strategies index (Maxwell & Caldwell, 2008). To keep the questionnaire lean for a phone survey, we assessed five coping strategies, including (1) reducing food intake – representing rationing strategies, (2) increasing food search, (3) using less nutritious/ desirable food – representing dietary change strategies, and (4) receiving support from government and (5) support from friends and family – representing external help.

6.3.4 Control variables

The main variable of interest in this empirical analysis is exposure to COVID-19 shock. In each of the three sites of the study, data collection took

place at a time when there were still very few cases[28]. Since actual disease exposure at the time was very low, we use a proxy to assess shock exposure. Other studies as well use proxies such as number of cases in region or variation in lockdown regulations (Amare et al., 2021). Our proxy measure was the perception of the effect of COVID-19 prevention policies on overall household welfare. We asked respondents *"On a scale of 1-5, how much effect has Coronavirus and related containment measures like lockdowns and curfews had on your general life?"* The Likert-scale response ranged from 1=very bad/negative effect to 5=very good/positive effect. We then created a shock exposure dummy that corresponded with 1 if households expected a very negative effect and 0 if households expected no or good effect.

Other control variables are guided by theoretical and empirical literature on strategies used by households in times of food shocks or uncertainties (Börner et al., 2015; Arouna et al., 2020; Barrett, 2020; Laborde et al., 2020; Savary et al., 2020). Some of these variables are household socio-economic, their level of social connectedness, and previous exposure to other shock events. We include household socio-economic and demographic characteristics like age, education. Household size, gender construct of the household, information access, wealth and income levels, as well as commercialization. While younger individuals (households) can be more proactive in the use of various food security strategies, their older counterparts may benefit from their large networks and build far better food resilience. Education levels improve access and use of information that can be support resilience during shocks. Households may use different strategies

[28] By end of July 2020, Kenya had 20,636 cases and Namibia had only 2129 cases (Hasell et al., 2020). Tanzania was not reporting and COVID-19 data

based on the amount and accuracy of the information they have (Mutisya et al., 2016). We use access to internet services as a proxy for information spread.

The task of family food production has historically been gender constructed. While men have the task to bring income and do more physically demanding household activities, women have been known to be more concerned with improving the food and nutrition security of most households (Tibesigwa and Visser, 2016; Theriault et al., 2017). We thus include the gender of the household head in our models to control for this relationship. In most rural areas, farm families are usually very large and made up of different members who are usually united in food consumption. Thus, we add the household size to understand how this matters in the use of various strategies.

In early 2020, East African countries experienced a locust infestation that was reported to be the worst in 70 years (FAO, 2020a; USAID, 2020). Though less publicised, locusts also affected Southern African countries, including Namibia (FAO, 2020b). In our sample, 16.5%, 23.7% and 27.8% of households in Namibia, Tanzania and Kenya respectively reported locust attacks on their farms. To capture the possible influence of locusts on various coping responses, we include locusts attack as a control.

Finally, perceptions of the levels of COVID-19 effect on households and associated coping mechanisms might depend on the pre-COVID-19 levels of welfare. For instance, richer households, those with more land and less exposure to shocks in previous periods are more likely to be resilient and less food insecure and therefore less likely to perceive an adverse effect of COVID-19 restrictions. We therefore include several pre-COVID-19

controls from the baseline survey to account for some pre-COVID resilience levels. Supplementary Table A1 provides the descriptive results along with the variable descriptions of all controls in the empirical model.

While we are confident that our sample is representative of the rural mobile phone-using population in Baringo (Kenya), Zambezi (Namibia) and the Kilombero valley (Tanzania), there might be some concerns due to attrition. Attrition in this case would be the difference between the total baseline sample (2227 households) and the prospective sample that was reached by phone. After updating our phone records, about 11% of our baseline households did not have a phone and therefore automatically attrited. This is contextual attrition in that we do not lose these households because they are not in our prospective sample. But one might be concerned about the possibility of structural differences between households we reached in the follow up and those we did not reach. We, therefore, verified if there are significant differences between households that we reached and did not reach based on some baseline covariates. As shown in the appendix, we establish no significant statistical relationship based on baseline covariates. We are therefore confident that our sample is random, and that attrition does not affect sample representativeness. To further confirm this, we also performed some attrition probit regressions using various baseline covariates and we still find that attrition is not driven by household baseline characteristics like phone ownership (full results in the appendix).

6.4 Results

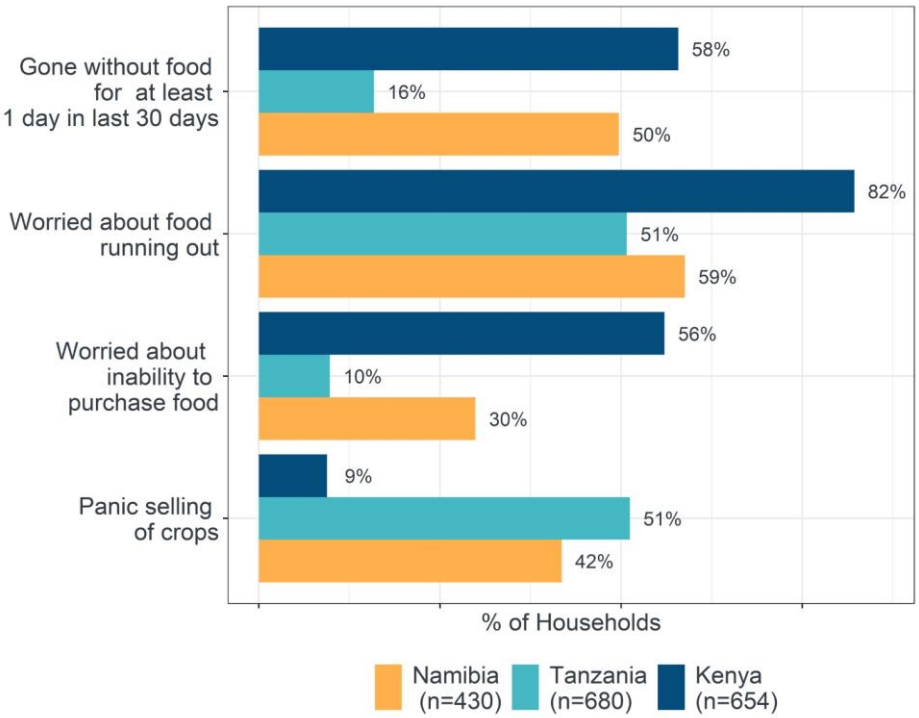
6.4.1 Evidence of food insecurity during COVID-19

First, we present evidence on the level of food insecurity during COVID-19 in the last 30 days. Figure 6.2 shows the different indicators of food

insecurity. We find that in Baringo County, Kenya, 58% of the households reported going without food for at least one day in the last 30 days. Going without food was lowest in Tanzania with just 16%, and about half the households in Zambezi, Namibia also had at least one day without food.

Worry about food security was highest in Kenya and lowest in Tanzania. In Kenya, 82% of the households were worried about running out of food, while in Namibia 59 % were worried. In Tanzania, despite relaxed COVID-19 regulations at the time of this study, 51 % of the households were worried about running out of food. Fifty-six percent of households in Kenya were worried about not being able to afford food while 30% and 10% were worried in Tanzania and Namibia respectively. This particular assessment sheds some light on income losses and the limited income-protection mechanisms households faced as observed in other studies (Egger et al., 2021; Josephson et al., 2021; Kansiime et al., 2021; Mahmud and Riley, 2021).

Figure 6.2 Food insecurity during COVID-19

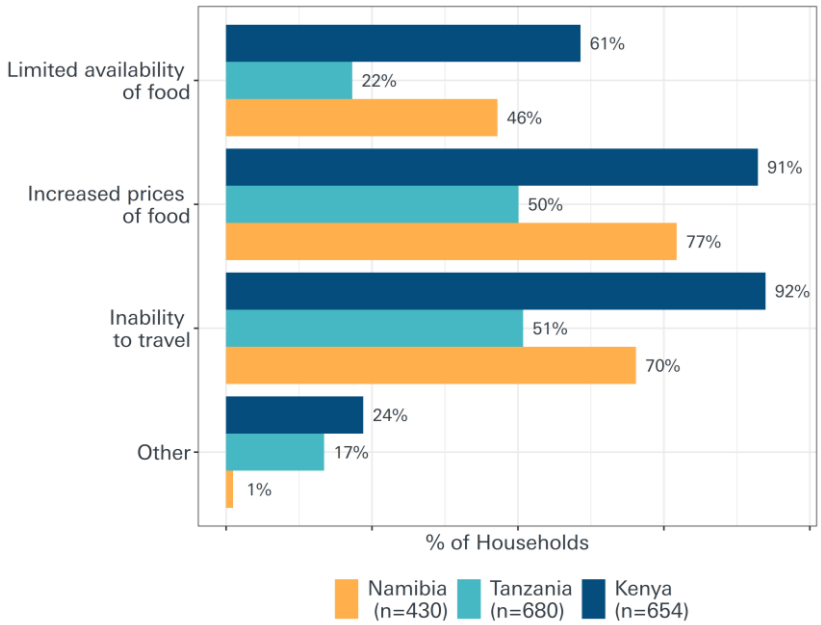


Finally, we assess panic sales of agricultural produce. Panic sale was assessed as a household having sold agricultural produce that they had not planned to sell at that time. On the one hand, while prevention policies such as lockdown fuelled panic buying and stockpiling of food items (Hobbs, 2020), the opposite – panic selling – puts households in a more precarious position when they sell at unfavourable prices. With the looming closure of markets, households are more likely to sell their stored produce at unfavourable times and prices. Possible low selling prices coupled with high prices of other foodstuffs might imply further exposure to food insecurity. Assessing the extent of panic selling, we find that it was highest in Tanzania, where 51% of households panic sold some of their agricultural produce, while 42% did so in Namibia. In Kenya, only 9% panic sold.

6.4.2 Evidence of COVID-19-related disruptions in food access

Next, we assess the extent of food-access disruptions. In the three study countries, food-access disruptions were reported most in Kenya (86%) and least in Tanzania (36%). In Namibia, 74% of the households reported at least one dimension of food-access disruptions. We assess four dimensions of food disruptions, namely limited availability of food, increase in the price of food, inability to travel to markets, and other disruptions. Results in Figure 6.3 indicate that in all the countries, an increase in food prices was the most-reported food-access disruption. In Kenya, 91% reported increased food prices, as did 77% in Namibia and 50% in Tanzania.

Figure 6.3 Food disruptions during COVID-19



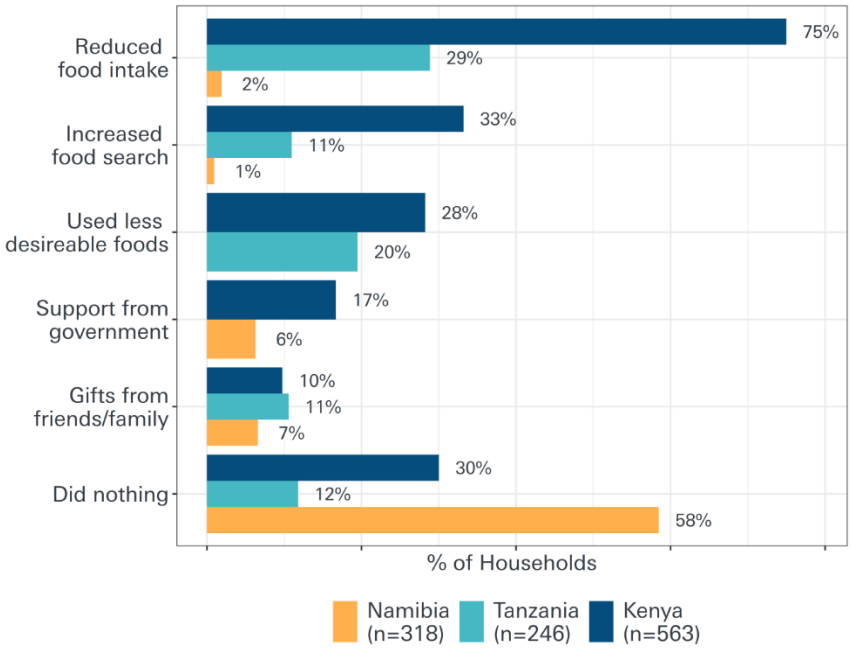
The second most prominent food disruption was the inability to travel to markets due to lockdown policies. In Kenya, 92% reported an inability to travel. Seventy percent were unable to travel in Nambia, and 51% in

Tanzania. We also recorded ‘other disruptions’ to food access, which were not precisely defined due to the nature of the phone survey. We show that in Kenya and Tanzania, 24% and 17% of the households respectively experienced other disruptions.

6.4.3 Household coping strategies against food insecurity and food disruption

Looking at the strategies employed by households in managing food-access disruptions, five main strategies were assessed. These strategies were (1) reducing their food intake, (2) increasing food search, (3) diversifying their food sources to include undesirable and less nutritious food, (4) food support from the government, and (5) food support from peers. Figure 6.4 shows the proportion of households relying on each of these strategies. First, we observe that in Kenya and Tanzania, the majority of households (75% and 29% respectively) reduced food intake. In Namibia, only 2% reduced food intake, 1% increased food search, 6% received support from the government and 7% received help from their social network.

Figure 6.4 COVID-19 and household coping strategies



In Kenya, 33% reported increasing food search and 28% resorted to undesirable foods. Only 17% receive some support from the government and 10% receive in-kind support from their social networks of friends and family. In Tanzania, 20% ate less desirable foods and 11% increased food search, and a similar proportion received support from family and friends. Of key note is that no one reported any government support in Tanzania. This resonates with the policy of the day regarding COVID-19 response.

One other strategy worth noting is the 'do-nothing' strategy. We do not include this strategy in the regression results that follow. However, we note that in each of our sites of study, a substantial proportion of households were faced with the COVID-19 food-security shock and did not have any recourse for help. In Namibia, this proportion was the highest at over 58%. In Kenya and Tanzania, 30% and 12% did not have any support,

respectively. These findings together with support from social networks (peers) are important for two reasons. First, we confirm from these the covariate nature of the COVID-19 shock on households such that while households usually rely on their social support network in the face of shocks (Börner et al., 2015; Yilma et al., 2014), this strategy is less applied when the shock is covariate and affects the whole community. Secondly, the results indicate the ineffectiveness of formal and government-led social support. In all sites, we observe that only a small proportion of those affected received any support from the government. Government interventions usually come in the form of cash or food transfers and can reduce or slow down the dive into poverty amid a crisis (Brum and Rosa, 2021; Gerard et al., 2020). However, if they reach only a small proportion of people, a large proportion will be left to the 'do nothing' strategy, and poverty will increase.

6.4.4 Association between the shocks and food-disruption coping strategies

In this sub-section, we present the results of the multivariate probit estimator on the association of the COVID-19 shock and the use of various coping strategies. We find that in each of the three sites, the negative effect of COVID-19 was high, corresponding to 67% in Namibia, 69% in Tanzania and 77 % in Kenya.

Table 6.2 reports the MVP model results for the relationship between the COVID-19 shocks and the use of different coping strategies by households. In each of the regressions, we include several household- and community-level controls. Our key outcome is COVID-19 shock, described as a shock if respondents mentioned that COVID-19 control policies had a generally negative effect on their food security situation. We observe that households

that reported a negative effect of COVID were more likely to rely on undesirable and less nutritious foods while they also reduced food search. This finding is expected as food search partly implies travelling to markets. At the time when lockdown and curfew policies were in place, food search would also be curtailed. Food insecurity was therefore more likely to increase as a result of the COVID-19 shock. We do not find a significant relationship between receiving support from the government and receiving support from social networks of friends and family. This finding reveals two issues. The first is the level of covariateness of the COVID-19 shock. COVID-19 control policies such as lockdowns and curfews affected households and communities in similar proportions. This implies a lower likelihood of community social support being an efficient safety net. Secondly, we observe a negative but insignificant coefficient regarding government support during the pandemic. That this strategy is not utilized significantly by households can imply that governments and other aid agencies are also both insufficiently prepared and logistically incapable of reaching the most at-need households in the pandemic. So, while social protection programmes have shown effective protection from the adverse effects of the pandemic (Abay et al., 2021a; Bottan et al., 2020; Brum and Rosa, 2021), they tend to cover only a small proportion of the population. Moreover, in a covariate shock like that caused by COVID-19, it would be logistically impossible to support all food-insecure households.

Table 6.2 Correlates of household's choice of food access strategies under the COVID shock

Variables	(1) M1	(2) M2	(3) M3	(4) M4	(5) M5
COVID-19 shock	0.128	-0.363*	0.790***	-0.105	0.213
	(0.164)	(0.156)	(0.213)	(0.149)	(0.139)
Locust shock	-0.153	0.080	-0.067	0.522***	0.336***
	(0.153)	(0.149)	(0.156)	(0.156)	(0.119)
Secondary education	-0.096	-0.238	0.284*	0.193	0.035
	(0.145)	(0.155)	(0.152)	(0.126)	(0.130)
Age of respondent	-0.000	-0.010*	0.010**	-0.005	0.004
	(0.004)	(0.005)	(0.005)	(0.003)	(0.003)
Male respondent	-0.042	0.052	-0.013	-0.051	0.030
	(0.109)	(0.128)	(0.106)	(0.112)	(0.092)
Household size	-0.047*	0.005	0.046**	-0.003	-0.019
	(0.021)	(0.021)	(0.019)	(0.022)	(0.020)
Crop storage	-0.143	-0.411*	0.067	0.702***	0.282**
	(0.165)	(0.174)	(0.162)	(0.163)	(0.142)
Access to internet	-0.192	0.163	0.071	-0.082	0.375**
	(0.153)	(0.230)	(0.177)	(0.224)	(0.157)
Log income (pre-covid)	0.019*	0.019	0.024	0.015	-0.031***
	(0.010)	(0.019)	(0.033)	(0.012)	(0.008)
Total income sources	0.050	0.010	-0.038	0.050	0.012
	(0.034)	(0.038)	(0.039)	(0.036)	(0.038)
Group membership (number)	0.001	-0.063	-0.066	0.070	0.045
	(0.076)	(0.085)	(0.069)	(0.077)	(0.062)
Previous shock responses (number)	-0.140	0.145	-0.120	-0.077	0.138
	(0.108)	(0.115)	(0.114)	(0.094)	(0.102)
Previous shocks (number)	-0.010	0.019	-0.018	-0.034	0.019
	(0.027)	(0.030)	(0.029)	(0.028)	(0.028)
Total livestock units	-0.002	-0.001	-0.005	0.003	0.002
	(0.003)	(0.004)	(0.004)	(0.003)	(0.003)
Land holding (acres)	-0.004	-0.000	-0.008	-0.001	-0.012*
	(0.007)	(0.006)	(0.008)	(0.007)	(0.007)
Wealth index (base: poorest)					

Poor	-0.076	-0.286**	0.362**	0.124	-0.159
	(0.183)	(0.137)	(0.160)	(0.132)	(0.119)
Average	0.173	-0.304*	0.379*	0.209	-0.111
	(0.187)	(0.165)	(0.196)	(0.151)	(0.138)
Richer	-0.253	-0.577**	0.122	-0.103	-0.290*
	(0.244)	(0.245)	(0.206)	(0.225)	(0.156)
Richest	0.074	-0.194	0.301	0.433	-0.308
	(0.261)	(0.253)	(0.232)	(0.321)	(0.207)
Travel time to cities	-0.002	-0.003*	0.002	-0.002	-0.001
	(0.002)	(0.002)	(0.002)	(0.002)	(0.002)
Mean aridity	-0.539	-0.730	-0.127	0.493	-0.022
	(0.393)	(0.608)	(0.425)	(0.566)	(0.492)
Human footprint	0.000	-0.013	0.039*	0.019	-0.014
	(0.023)	(0.028)	(0.022)	(0.019)	(0.015)
Constant	2.501	4.436	-2.491	-4.089	-0.520
	(3.216)	(4.810)	(3.635)	(4.510)	(3.956)
Observations	1,120	1,120	1,120	1,120	1,120
District FEs	Yes	Yes	Yes	Yes	Yes
Country FEs	Yes	Yes	Yes	Yes	Yes

Notes: Each row is an independent regression. M1 = Reduced food intake M2 = Food search M3 = Less nutritious foods M4 = Food support from government M5 = Food support from peers. Standard errors in parentheses adjusted for 147 clusters/enumeration areas. District, and country fixed effects. Robust standard errors clustered at enumeration areas in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

In early 2020, East African countries experienced a locust infestation that was reported to be the worst in 70 years (FAO 2020a; USAID 2020). Though less publicized, locusts also affected Southern African countries, including Namibia (FAO 2020b). In our sample, 16.5%, 23.7% and 27.8% of households in Namibia, Tanzania and Kenya respectively reported locust attacks on their farms. To capture the possible influence of locusts on various coping responses, we include locust attack as a control. We find that locust shock did not increase or reduce food search, lead to consumption of less nutritious food or the reduction of food intake in general. However, we observe increased support from government and aid agencies and social

network support. Locusts are a lesser covariate shock compared to COVID-19. Households can support each other and governments and aid agencies can logistically target the most affected.

6.4.5 Complementarities and substitutabilities among strategies

One key advantage of the MVP estimator is its ability to extract interdependencies between the use of various food-access strategies. To do so, the model generates correlation matrices that enable the observation of synergies and trade-offs in the use of the various strategies. As expected, some significant correlations were observed between the error terms of the strategies against food-access disruption equations.

Because COVID-19 is a large-scale covariate shock on households, we expect that households employ multiple coping strategies. Single strategies might be insufficient. We therefore expect strong correlations between the strategies. As depicted in Table 6.3, we observe significant and positive relationships between the strategies, suggesting complementary relationships in their utilizations. We observe that reducing food intake is highly correlated with eating less nutritious foods and also increasing food search (possibly including depending on wild foods). We also observe that receiving support from family and friends is correlated with receiving support from governments and aid agencies. In countries like Kenya and Tanzania, widespread mobile money services are an effective way of sending support to vulnerable households and are increasingly adopted by governments and aid agencies in humanitarian situations (Bailey, 2017). These strategies, therefore, tend to complement each other. The downside of this complementarity is that less-connected households are then more likely to be excluded from relief efforts.

Table 6.3 Correlation matrix from the multivariate probit model under the COVID shock

	M1	**M2**	**M3**	**M4**	**M5**
M1	1				
M2	0.237**	1			
	(0.111)				
M3	0.320***	0.030	1		
	(0.091)	(0.072)			
M4	0.015	-0.182	0.044	1	
	(0.102)	(0.120)	(0.102)		
M5	-0.030	-0.134	-0.063	0.358***	1
	(0.077)	(0.105)	(0.072)	(0.073)	

Note: M1 = Reduced food intake M2 = Food search M3 = Less nutritious foods M4 = Food support from government M5 = Food support from peers. Standard errors clustered at enumeration areas are in parentheses. ***p<0.01, **p<0.05, *p<0.1

6.4.6 Heterogeneity in the three countries

We are further interested in highlighting the cross-country differences. Tanzania did not implement similar COVID-19 control mechanisms to those adopted by many other countries (Buguzi, 2021). We therefore expect some differences. As seen in Figure 4, coping mechanisms employed also mirror prevention policies implemented. For instance in Tanzania, no respondent received government support because the government partly downplayed the existence of COVID-19 (Buguzi, 2021) and also argued that standard policies were untenable in the country for livelihoods and food-security reasons (Mfinanga et al., 2021).

To observe heterogeneity, we conduct individual country analyses. Table 6.4 shows these results. We observe that in Kenya, all five coping mechanisms studied were employed by households, and the results are more or less similar to the pooled model in Table 6.2. Households in Kenya reduced food search but increased reliance on less nutritious and undesirable

foods. Also, as in the pooled model, we observe that households in Kenya received government support and support from social networks with locust shocks. In Tanzania, we observed an increase in reducing food intake and reliance on undesirable foods. We do not see any significant correlations regarding locusts. In Namibia, only two coping mechanisms are predominant, and the others are dropped from the model due to extremely low reliance rates (see Figure 6.4). We do not see any significant associations implying that in Namibia, reliance on these coping mechanisms was not driven by COVID-19 or even locust attacks.

Table 6.4 Heterogeneous assessment of coping strategies across three sites

Variables	M1	M2	M3	M4	M5
			Kenya		
COVID-19 shock	0.090	-0.475**	0.801***	-0.000	0.531**
	(0.226)	(0.161)	(0.248)	(0.186)	(0.242)
Locust shock	0.094	0.057	-0.026	0.701***	0.755***
	(0.221)	(0.177)	(0.189)	(0.205)	(0.178)
Observations	563	563	563	563	563
			Tanzania		
COVID-19 shock	0.406*	1.189	0.915**		0.137
	(0.221)	(0.732)	(0.401)		(0.243)
Locust shock	-0.364	-0.363	-0.251		-0.266
	(0.244)	(0.343)	(0.316)		(0.254)
Observations	246	246	246		246
			Namibia		
COVID -19 shock				-0.149	-0.154
				(0.238)	(0.239)
Locust shock				0.359	0.164
				(0.247)	(0.276)
Observations				311	311
Other controls	Yes	Yes	Yes	Yes	Yes
District FEs	Yes	Yes	Yes	Yes	Yes

Notes: Each row is an independent regression. M1 = Reduced food intake M2 = Food search M3 = Less nutritious foods M4 = Food support from government M5 = Food support from peers. Standard errors in parentheses adjusted for 147 clusters/enumeration areas. District, and country fixed effects. Robust standard errors clustered at enumeration areas in parentheses. *** p<0.01, ** p<0.05, * p<0.1. All models include Additional household socioeconomic controls as in the pooled model (Table 3).

6.5 Conclusion

In this study, we investigated the level of food insecurity in mid-2020, a time when African countries were struggling with the increasing cases of COVID-19 and thus implementing restrictive policies to reduce infections.

While these restrictive policies might have averted many infections, they curtailed economic activities and worsen food security situations.

We used unique phone-based survey data from 1,754 smallholder households across Kenya, Tanzania, and Namibia. Descriptive results show that majority of households across the three countries had at least one dimension of food insecurity. In each of the three countries, households were worried about running out of food more than other dimensions, and a substantial proportion of households engaged in panic selling of their crop produce during COVID-19. Furthermore, we observe that a substantially large number of households experienced multiple food-access disruptions, with Kenya being the most affected of the three countries. To some extent, the policy environment in Tanzania protected households from the COVID-19-related food insecurities. We find that reducing food intake was the most prominent coping strategy.

Combining the phone survey data with pre-COVID-19 data, we assessed the effect of the association of COVID-19 on various coping mechanisms. We further controlled for pre-COVID-19 socioeconomic conditions and implemented a multivariate probit regression (MVP) model that extracted associations and also revealed complementarities between various strategies. A key contribution we made in this analysis of associations of coping mechanisms is controlling for locust infestation shock, which affected all the countries. Results from the MVP estimator show that COVID-19 was associated with dependence on rationing (reducing food intake) and dietary change (relying on less nutritious and undesirable foods) strategies, but government/humanitarian and informed social-support systems were insufficient due to the covariateness of the shock. We observe that to some extent, households that were affected by locusts received some

government and informal support, which can be explained by the less covariate nature of locust attacks. In general, households apply multiple coping mechanisms. Finally, we reveal complementarities in the strategies applied.

Overall, our findings suggest that rural households in Kenya, Tanzania, and Namibia have suffered food-access disruption. This may be due in part to the national lockdowns and the already looming food insecurity in most of these rural areas. Given the extent and scope of food intake and the reliance on less nutritious foods, social and governmental support is needed, and would go a long way toward offsetting some of these reductions in food and nutrition security. Apart from institution support, food-storage and market-stabilization policies and action are needed, especially as the COVID-19 situation continues to evolve negatively in many countries. While urban poverty will be an issue that worries policymakers, governments need not overlook the lived realities of the majority of people in rural areas who are not reached by relief efforts. These results will be essential to policymakers and food security researchers interested in exploring the dimension of food insecurity during COVID-19 in African countries, especially with a rural dimension.

6.6 References

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6.7 Appendix

Table A26 Summary statistics of control variables

Variable	**N**	**Overall**, N = 1,764[1]	**Namibia**, N = 430[1]	**Tanzania**, N = 680[1]	**Kenya**, N = 654[1]	**p-value**[2]
Household fields were attacked by locust (1=Yes)	1,764	414 (23%)	71 (17%)	161 (24%)	182 (28%)	<0.001
Household negatively affected by COVID (1=Yes)	1,764	1,264 (72%)	290 (67%)	468 (69%)	506 (77%)	<0.001
Secondary education (1=Yes)	1,764	549 (31%)	292 (68%)	90 (13%)	167 (26%)	<0.001
Age of household head in years	1,764	43.05(14.97)	44.68(15.71)	44.85(15.03)	40.11(13.92)	<0.001
Number of household members	1,759	5.36(2.65)	5.00(2.40)	4.60(2.19)	6.39(2.91)	<0.001
Tropical Livestock Unit	1,764	8.21(15.31)	8.93(15.54)	1.73(4.97)	14.47(19.11)	<0.001
Household sold food crops (1=Yes)	1,764	568 (32%)	25 (5.8%)	287 (42%)	256 (39%)	<0.001
Household has food stored at home (1=Yes)	1,764	543 (31%)	158 (37%)	309 (45%)	76 (12%)	<0.001
Household has access to internet services (1=Yes)	1,764	188 (11%)	35 (8.1%)	67 (9.9%)	86 (13%)	0.022
Household lost job	1,764	295 (17%)	89 (21%)	91 (13%)	115 (18%)	0.005

Variable	N	**Overall**, N = 1,764[1]	**Namibia**, N = 430[1]	**Tanzania**, N = 680[1]	**Kenya**, N = 654[1]	**p-value**[2]
(1=Yes))						
Household monthly income in $ PPP (ln)[3]	1,764	4.20(4.58)	4.72(4.57)	3.48(5.40)	4.62(3.42)	<0.001
Number of Associations the household belongs to	1,762	0.39(0.75)	0.32(0.61)	0.59(0.90)	0.23(0.60)	<0.001
Total number of income sources	1,762	2.84(1.45)	2.59(1.43)	2.86(1.41)	2.98(1.49)	<0.001
Gender of the household head (Male=1)	1,759	1,050 (60%)	268 (63%)	342 (50%)	440 (67%)	<0.001
Average Number of responses for past shocks	1,762	0.66(0.51)	0.51(0.47)	0.63(0.42)	0.79(0.58)	<0.001
Land Ownership (acres)	1,762	4.33(7.80)	10.10(9.84)	2.20(2.92)	2.76(7.91)	<0.001
Asset quantile	1,759					<0.001
1=poorest		288 (16%)	123 (29%)	14 (2.1%)	151 (23%)	
2=poor		565 (32%)	186 (44%)	63 (9.3%)	316 (48%)	
3=average		268 (15%)	70 (16%)	72 (11%)	126 (19%)	
4=rich		324 (18%)	33 (7.8%)	246 (36%)	45 (6.9%)	
5=richest		314 (18%)	13 (3.1%)	285 (42%)	16 (2.4%)	
Travel time to cities (20-50 thousand) in	1,755	69.17(61.63)	50.89(34.91)	70.23(50.67)	79.94(80.12)	<0.001

Variable	N	**Overall**, N = 1,764[1]	**Namibia**, N = 430[1]	**Tanzania**, N = 680[1]	**Kenya**, N = 654[1]	**p-value**[2]
Minutes						
Aridity Index of household location	1,755	8.31(0.49)	7.82(0.07)	8.77(0.43)	8.14(0.21)	<0.001
Human Footprint of the household location	1,755	8.99(4.86)	6.10(3.39)	8.70(5.09)	11.15(4.35)	<0.001
Number of past shocks the household exposed to (Weighted by Severity)	1,762	3.88(1.98)	3.74(1.66)	3.34(1.64)	4.53(2.29)	<0.001

[1]Statistics presented: n (%); Mean (SD)

[2]Statistical tests performed: chi-square test of independence; Kruskal-Wallis test

[3]Household monthly income if converted to US dollars purchasing power parity using the 2017 World Bank International Comparison Program (ICP) corresponding to 1USD= 40.185 Kenyan Shillings, 885.083 Tanzanian Shilling and 7.021 Namibian dollars respectively.

Table A27 Mean difference between Attrited and Non-attrited households

Characteristic	Not reached N = 327	Reached N = 1,901	p-value[1]
Was able to save money last month	76 (23%)	423 (22%)	0.67
Uses Mobile Money	129 (40%)	751 (40%)	0.98
Respondent is Male	194 (61%)	1,143 (60%)	0.91
Age of respondent in years	44.94(17.22)	43.75(16.71)	0.24

Age of head in years	49.24(16.37)	48.62(16.00)	0.52
Has income from Business	57 (18%)	318 (17%)	0.72
Head has secondary education	110 (34%)	507 (27%)	0.009
Number of Associations	0.35(0.69)	0.39(0.74)	0.38
Total number of income sources	2.73(1.52)	2.82(1.45)	0.34
Household head is Male	201 (63%)	1,291 (71%)	0.008
Total number of shocks	4.29(2.15)	4.64(2.19)	0.009
Average number of responses for past shocks	0.69(0.57)	0.65(0.50)	0.21
Land Owned in Ha	5.28(8.16)	4.55(8.01)	0.13
Travel time to cities (20-50 thousand) in Minutes	60.93(51.49)	68.88(60.75)	0.027
Tropical Livestock Unit	7.68(16.27)	8.23(15.52)	0.56
Number of household members	4.93(2.40)	5.34(2.65)	0.01
Household head is Male	201 (63%)	1,306 (70%)	0.012
Has mobile phone	274 (84%)	1,546 (81%)	0.29

Note: n (%); Mean (SD)
1 Pearson's Chi-squared test; Two Sample t-test

Table A28 Attrition Probit Model

	Attrited	**Attrited**
(Intercept)	0.32 ***	0.36 ***
	(0.28 – 0.38)	(0.25 – 0.52)
Has mobile phone	1.1	1.17
	(0.93 – 1.30)	(0.95 – 1.43)
Was able to save money last month		1.06
		(0.90 – 1.25)
Uses Mobile Money		0.97
		(0.83 – 1.13)
Age of respondent in years		1
		(1.00 – 1.01)

Has income from Business		1.1 (0.91 – 1.32)
Head has secondary education		1.16 (0.99 – 1.35)
Number of Associations		0.94 (0.85 – 1.05)
Total number of income sources		0.97 (0.93 – 1.03)
Household head is Male		0.87 (0.75 – 1.01)
Total number of shocks		0.96 * (0.93 – 1.00)
Average number of responses for past shocks		1.14 (0.98 – 1.31)
Land Owned in Ha		1 (1.00 – 1.01)
Tropical Livestock Unit		1 (1.00 – 1.01)
Number of household members		0.98 (0.96 – 1.01)
Observations	2228	2110
R2 Nagelkerke	0.001	0.025
AIC	1861.265	1736.57
AICc	1861.271	1736.8
log-Likelihood	-928.633	-853.285

* p<0.05 ** p<0.01 *** p<0.001