Community resilience and the dynamics of relatedness and residence in a rural Zimbabwean village from 1986 to 2010

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ABSTRACT

Social resilience to challenges is an important component of sustainability. We explore the diversity and flexibility of the social networks of a rural Zimbabwean community in order to understand their resilience in the face of the AIDS epidemic, hyper-inflation in the 2000s, and increasing variability of rainfall due to climate change. We combine social network analysis with ethnographic accounts to find that broad concepts of relatedness help families adopt AIDS orphans, while household structures are flexible over time, with small groups forming in lands newly available for re-settlement. Change in household membership was attributable more to immigration/emigration than to birth/death. [1]

KEYWORDS
social network diversity, ethnography, sustainability, kinship, households, mixed methods

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INTRODUCTION

Defining what sustainability looks like in a particular location and community has often proven to be challenging, particularly when the baseline is shifting as in climate change, or when there are sudden shocks to the system such as epidemics or wars. In a system affected by sudden changes or disturbances, resilience becomes an important part of maintaining certain levels or types of socio-ecosystem functions over time (that is, sustaining the system). Ecological resilience as originally proposed by Holling refers to the ability of a system to retain its functions and feedbacks in the face of disturbance (Holling 1973). Both desirable and undesirable states can be resilient to disturbances, so sustainability includes judgments about the relative ability of different states to meet human needs in the long term (Carpenter et al. 2001). Rural communities in the global South can be surprisingly resilient in the face of challenges like political and economic instability, wars, epidemics, and climate change. What aspects of these communities reinforce their ability to persist and recover to a desirable state (which includes positive public health outcomes, improved economic attainment, and increased food security) when faced with these kinds of external shocks? Can those aspects be studied, highlighted, and supported to improve the equity and sustainability of these systems? In this paper, we ask these questions about the social networks of a rural Zimbabwean farming community. We make the argument that systems with diverse and flexible mechanisms for responding to challenges are more likely to recover from a disturbance, and that this community's social networks are both diverse and flexible.

A diversity of networks provides redundant solutions

One aspect of individual and collective social functioning is the mutual support of a strong community. Recent studies have investigated the health benefits of social support (Shor, Roelfs, and Yogev 2013, and references therein). In the same sense that network diversity improves an ecosystem's resilience through redundancy of groups performing similar functions (Pimm et al. 1991; Williams and Martinez 2000; Dunne et al. 2008), a diversity of social networks can improve a social system's resilience (Goulden et al. 2013), or the success of individual actors in such a system (Stoloff, Glanville, and Bienenstock 1999). Greater connectivity (another kind of redundancy) of these networks can ensure a wider range of livelihood strategies and can improve resilience (Cassidy and Barnes 2012), and traditional networks, including kinship and clan systems, can be key in adapting, developing, and administering externally-conceived aid programs including in the medical

field (Katabarwa, Richards, Ndyomugyenyi 2000). The recognition that rural communities are not empty spaces waiting to be filled with aid and services underlines how culturally sensitive solutions are needed that understand the ways in which communities can help each other in times of need.

Flexible networks allow quick adaptation to emerging issues

Alongside a greater diversity of more highly connected networks, greater dynamism or flexibility in some or all of those networks may also support resilience and therefore potential sustainability in these communities. Network dynamism is a long-recognized phenomenon and bane of static analyses and datasets (Jacobson 1985), and longitudinal studies of networks are under development (de Nooy 2011). Some network characteristics are stable over time, while others vary substantially or change depending on the averaging window being used; indeed network characteristics can remain quite stable while individual connections vary considerably (Kossinets and Watts 2006). Personal networks can change a great deal over time, with persistent intimate ties reflecting social support or kinship (Wellman et al. 1997), and studies have shown low levels of stability in conversational networks in rural Malawi (Bignami-Van Assche 2005) and rural Kenya (White and Watkins 2000) when re-surveyed. Social network dynamism may be commonplace, but may also be a source of resilience due to the flexibility of various social structures.

For example, households as a social network are often referred to as flexible (Netting, Wilk, and Arnould 1984). In many situations they can change a great deal over time in response to changing resource availability and in response to external shocks, for example dividing into smaller households to adapt to new socio-economic conditions (Lam 2015). Much productive field research, especially on livelihoods, has focused on the household level, assessing quantitative and qualitative change in wellbeing/poverty over time (for example, Dorward 2009; Davis and Baulch 2009). More rarely have studies focused on how success at a household level may diverge from the wellbeing of the individuals located within those households (for an interesting example of the latter see Camfield and Roelen 2011). We argue that from this perspective individuals flow through different households over time both as a cause and consequence of "success"[2] or "failure" of that household, and such mobility is not passive but reflects how individual people over time in such

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2   Throughout, we use double-quotation marks when using terms for which we want to discuss the use, for example, "households" or "kinship;" in this sense, they stand in for the phrase "so-called." Once we have discussed or defined a term we no longer use quotation marks. We use italics for words in Shona.

societies can deploy different relationships to achieve their needs. Resilience may also lie in the cohesion of larger structures or networks than those of household and in the many varied interactions between individuals.

Flexibility and diversity in rural Zimbabwean social networks

Using data covering a cluster of Zimbabwean households in the period 1986 to 2010, this paper combines network-based methodologies with ethnographic accounts to demonstrate the diversity of networks and how people rely on them through periods of change and in crises, focusing on the flexibility and interplay of two of these networks: relatedness and residence. Residence, in particular (in the form of "household membership" which we take care to describe using culturally appropriate concepts), is highly dynamic, changing a great deal from year to year and across a generation. Our mixed-methods approach allows us to use the strengths of quantitative network analysis to capture the dynamism and flexibility of residence networks, alongside the strengths of qualitative ethnographic descriptions to represent and explore the diversity of other networks which provide redundancy with residence networks.

We use these analyses to answer the following questions: How stable are households and household membership over time? Are changes in households more attributable to births and deaths, or to migration in and out of the household? How related (by several different definitions) are individuals within a household and how has their relatedness changed over time? How do individuals move between households, and do they select households to join based on geographical convenience or economic means? These questions together with qualitative information on particular household trajectories begin to answer the larger question: When presented with challenges like economic crisis, disease, or climate change, how do people and their social networks respond in this community?

METHODS

Study system and data collection

Mazvihwa Communal Area (in Zvishavane district of Midlands Province) is typical of heavily populated semi-arid areas in the south of Zimbabwe. Independence in 1980 initially brought greater incomes and improved services; but during the 1990s and then

2000s a series of shocks including severe drought, economic "structural adjustment,"[3] AIDS, political instability and hyper-inflation compounded the challenges of long-term trends of declining and increasingly variable rainfall and loss of environmental resources. Yet while Zimbabwe is typically cited as a country in deep crisis, empirical assessments of human well-being in this community – whether for assets, production or human wellbeing – show surprising resilience, remaining in desirable states despite those challenges and even improving with time. For example, in Mazvihwa as a whole, the infant mortality rate has continued to decline (nearly halving to around 30/1000 from the 1980s to the 2000s), and even with an HIV-AIDS related increase in the 1990s, the child mortality rate remained below 50/1000 (Appendix A, Figure A1). Likewise, and despite these economic conditions, including some major moments of shock, careful long term monitoring of assets such as agricultural equipment and electronics show increases in what people have (Figure A2), and the principal productive asset of this agro-pastoral system – cattle ownership – is shown to have significantly increased per person and per household (Figure A3).

To understand this resilience to external challenges via characterization of the diversity and flexibility of their social networks, we examined a group who refer to themselves as the Chinguo (after their common ancestor who died around 1950). In the nineteenth century they lived on a defensive hill called Murupe in the Marozve Ward under Chief Mazvihwa, but early in the twentieth century they moved to an area between the hills and the Runde River a few kilometers to the north, where they are still clustered today, though they now have satellite households in lands twenty kilometers further north that were within the territory of Marozve in the nineteenth century that spent the last hundred years in the hands of mining companies as commercial ranches.

Data collection on the Chinguo began in the mid-1980s for a doctoral thesis on livelihood, ecology and welfare (Wilson 1990). The larger study included households from across Mazvihwa Communal Area, stratified to include all villages and to represent the geographic variability of the area. (We define households below in *Karanga cultural context and definition of "relatedness" and "residence"* and household selection criteria in *Initial sampling of households and delineation of household network.*) Over the last thirty years members of the community, including individuals from these households, were trained as field assistants and became highly motivated community-based researchers

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3   Structural adjustment was a World Bank/International Monetary Fund policy prescription widely applied in Africa during the 1990s that cut back on government expenditures including social services, liberalized markets and removed protection for local industries; bank theorists believed the long term benefits would outweigh the short term turmoil this created (Sachikonye 1999).

monitoring household affiliation, kin relationships, activities and wellbeing, with research focused around four periods of several years each, identified by the middle year of each survey: 1986, 1992, 1999 and 2010.

Karanga cultural context and definition of "relatedness" and "residence"

For the Karanga people of Mazvihwa, "relatedness," "kinship," "household," and "residence" have meanings not necessarily aligned with classical anthropological definitions of the terms (see Appendix B for a brief review and criticism of these terms). Both because real sustainability involves culturally-appropriate solutions, terminology and concepts, and because our research was community-based, we take special care to define these terms in the context of Karanga culture. In this section, we describe "clan" affiliations (*mutupo*), definitions of "relatedness" or "kinship" (*ukama*), and "household" (*musha*). In the following sections on the delineation of the household and kinship networks, we describe the definitions of nodes and edges in those networks using both these Karanga terms and classical, Euro-American-centric anthropological terms. Generally in this paper, we tend to use the word "kinship" when the classical definitions dominate, and follow Carsten (2000) in using "relatedness" to evoke a broader definition of kinship when referring to Karanga concepts of kinship. Despite Stone (2002)'s criticism of its breadth, we prefer "relatedness" to be deliberately vague to allow room for a wider variety of interpretations.

Clans, formation of households, household owners and household heads

In Mazvihwa, *mutupo* (clan), usually identified with an animal, is fundamental to origins and identity and is inherited through the father. The most populous clans in Mazvihwa are the fish (*hove*), the elephant (*zhou*), the lion (*shumba*), and the heart (*moyo*). Unless a formal ceremony is conducted to break the clan link (*kucheka ukama*) people must marry from another clan. With marriage substantial bride-wealth (*rovora/lobola*) is exchanged (including real or symbolic cattle) and this binds the families as well as the couple together and compensates the wife's family for the transfer of her labor and children to the husband's family and clan. Thus women marry in from other villages and reside in their husband's clan's village after marriage, while men create new households around their father's home within the same village when they marry. To create a new household, men inherit land from within their clan, usually from the men of their father's or grandfather's families (patrilineage), and/or they request additional parcels from local

headmen (*sabhuku* and *muchinda[4]*), building their new households with their dependents. Land held by women is also typically inherited by their sons and not their daughters. The men who establish these homes are considered the "owner" (*mwene/muridzi*) of the household because the physical space upon which the home is constructed is granted to them as an individual, and typically this is ritually sanctified (with an *mbambo* stone) and nested within the spiritual rights of the clan family in question. In this paper, when we refer to a "household head" we are referring to the person who plays the lead role in decision-making for that household. This person will be the "owner" when present, but in their absence (often due to recent death or labor migration) the household head can be another person, typically a spouse or son. Individuals and households in this community often cycle through stages of creation, growth, and production of new households in turn (Fortes 1962). Against this backdrop of cycling, individuals may move back to their natal household, for various reasons, especially when that home is the leading one in their extended family. Daughters, in particular, may return after a divorce or if they are widowed when young, and the next generation of children may come back to help out their grandparents.

Definition and functions of households

All that said, there is actually no local word for "household." The term typically used, *musha*, is a generic term for village (compare with *nzanga,* a term used in the past for then typically very large homesteads under a strong patriarch). Nevertheless, Karanga people, like other Southern Africans, have a strong sense that the household is a key unit in their society which generally fits the model above. However, while this is the dominant framework for households in Mazvihwa, it fails to reflect the complexity revealed by thirty years of study in this community where almost any configuration of household has been encountered and a high degree of creative flexibility observed.

Defining households by their functions also proves problematic in Mazvihwa. Contrary to various definitions, in this culture households do not act as units of asset holding, production, consumption and/or residence. First, neither land, cattle nor any other assets are owned by households; instead these are acquired and owned by individuals who use them for individual benefit or sharing through relationships within and outside the household. Households are also only rather weakly the units of production, for while

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4   Individuals who represent the traditional Hove (fish clan) chiefs of this area who seek to exercise cultural stewardship and control of land and resource access

members are expected to make contributions to shared wellbeing, they typically also have activities undertaken on their own basis and/or with people in other households. Households in Mazvihwa are also not units of food consumption, these instead being "kitchens" (*zvoto*). Kitchens are owned and controlled by individual women in connection with gardens and granaries in which they hold their own rights, as well as in connection to the granaries of other field holders (especially male household heads). Multi-generational and polygamous households (*musha*) typically have several kitchens (*zvoto*) operating, in which different household members have different rights to eat. Finally, complicating any sense of "household" as "residence," many members of a household, including its owner, may be absent as labor migrants, often for large periods of life during which remittances are provided and home visits and other engagement in household affairs can be intense or distant.

Definition of relatedness

Household members are expected to be able to demonstrate their relatedness (*ukama*), broadly framed, to the household head. Part of the creative resilience of their clan system is the diversity of ways that this is possible. For Karanga people, relatedness may have multiple meanings based on a variety of cultural, family, clan and economic grounds. For example, fellow clan members are considered to be brothers and sisters, even when there appears to be no family connection for many generations. Similarly, people are considered to have a relationship with anyone who shares a clan identity with their mother; and when a man marries a woman of a particular clan he immediately has a new and different relationship with the men and women of his wife's clan. Within the family, one typically refers to both brothers and certain cousins of the same generation as "brother." These concepts of relatedness may also reflect historical collaboration between clans and lineages, such as between the Elephant and Crocodile clans in Chinguo village, as is discussed below.

Given the breadth of these definitions of household and kinship, the approach of this paper was to ask the community members themselves whether they identified as related and to what household they belonged. The community research team then established relatedness (including the more narrow definition given below of marriage or parentage) through painstaking interviews and established household residence or contributions through frequent home visits.

Initial sampling of households and delineation of household network

In the initial 1980s Mazvihwa-wide sampling, one representative "focal" household in each village of Mhototi Ward was chosen with the guidance of the late Ward Councilor, Mr. Bwoni, and late local Headmaster Mr. C.G. Mukamuri. Individuals in the focal household were then asked what other households they worked intimately with, creating a larger cluster to avoid the problems associated with studying households in imagined isolation. These judgments of household-to-household interaction were also confirmed with other members of the community. Sharing of cattle was determined to be the most significant measure of interaction, so field observation of cattle sharing was used to confirm what respondents claimed about their connections with other households. This procedure defined a set of initial households for the survey. Households were added to the cluster when a current or former member of the cluster established a new rural household as household head in a new physical space, or a member of the patrilineage of the nodal household returned in the face of divorce, job loss or other hardship. Where one individual took over a household in the same physical space (e.g. a widow from her husband) we considered that to be the same household. Households were considered closed when nobody remained living at that physical site (e.g. where dissolution occurred with the death of the household head). Though the method was initially developed to understand agro-pastoral production, it proved highly germane for the current purposes of understanding social networks over the following three decades. Note that all information in the appendices which refers to all of Mazvihwa is referring to this larger sample of households, their affiliates, and the households which split off from them.

The household cluster in Chinguo was selected for the present study because it was of manageable size and considered representative of Mazvihwa Communal Area as a whole by the community research team. This cluster includes members of the Zhou or elephant clan and a closely associated outsider (*vaTogwa*) lineage of the Ngwenya or crocodile clan. The household network our study is based on therefore contained as nodes the initial focal Chinguo household from the 1980s doctoral thesis study, the households it worked intimately with at that time, and any households which were created from those households in the following 30 years. Individuals were associated with a household in a given year if they were physically present in the household and/or making material contributions, even if only intermittently (for example, as labor migrants sending remittances and/or returning for holidays) and if they themselves identified with that household as their *musha* (village). Individuals who did not maintain active connections

to those households were considered not to be residents of households, even while the researchers included them in family trees and continued to track their status and association with other urban or rural households. Thus, we use community-defined criteria to select households in the initial survey and to define household membership (local views, physical residence and/or contributions), as in Mcilvaine-Newsad, Sullivan, and Dougherty (2003). We make this definition of household membership sufficiently broad in order to contain the many flexible models and diverse cases found in our system.

Though the edges used in initially defining the household network in the 1980s included collaboration via cattle sharing and formation by splitting off from an existing household, for our analysis we do not use those relationships and instead use the original household network in two novel ways. First, we use household membership as an attribute of individual people as a method for delineating the boundary of the kinship network (see below in *Delineation of partial kinship network*). Second, we used the bipartite network of individuals and the households they have been associated with over time to create edges between households based on their exchange of individuals using a matrix projection (see below in *Household location (spatial distance) and exchange of individuals*).

Delineation of partial kinship network

For the purpose of the quantitative analysis, we combine classical Euro-American-centric definitions of kinship with Karanga concepts of relatedness. To define the edges in the kinship network, we use steps of one civil kinship degree (connections between parents and children or between spouses; also referred to as roman degree or "length" in Hamberger, Houseman, and White 2011; hereafter referred to as "civil degree distance"). To choose whether to include nodes, however, we use Karanga concepts of relatedness. We integrate these ideas by applying a simple rule to construct the partial kinship network: starting with Karanga assessments of relatedness between household members, 1) add nodes one additional civil degree away from the existing nodes until 2) the network includes all individuals necessary for the genealogy's representation of "related" to agree with the qualitative self-reports of relatedness from the interviews (Figure 1).

To apply this rule, we calculated the minimum civil degree distance between each pair of household members. We added individuals (nodes) until the computed pairwise civil degree distance was minimal between people within the same household, based on the interview data: if individuals self-identified as related (for example, "she's my sister"), we

included as many relatives as needed to connect them using only single-civil-degree links (for example, including one or both of the two sisters' parents from a neighboring province). In many households in Chinguo, nearly all individuals are related to one another via several single-civil-degree steps, and typically more steps than one. Therefore, the civil degree distance must be finite with the exception of individuals confirmed to be unrelated in the qualitative data. This method means, for example, including a deceased ancestor in order to allow us to see that two descendants are related.
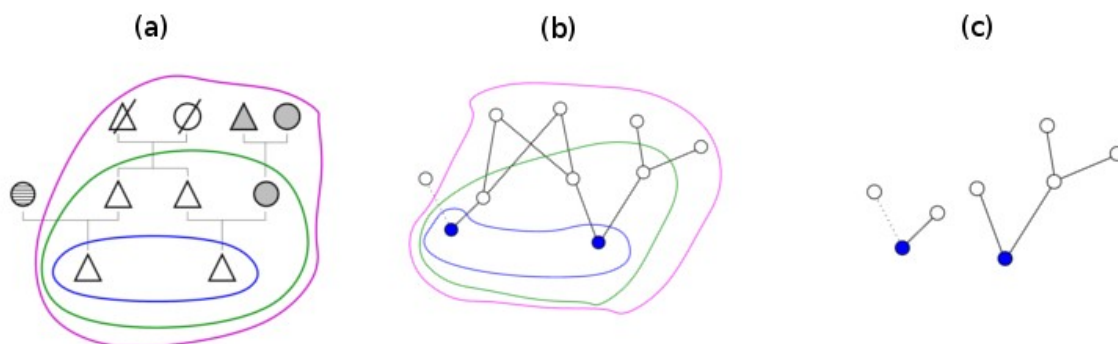
Figure 1: Explanation of partial kinship network boundary delineation. The two cousins circled in blue are members of the same household. We expand the kinship network boundary until we can connect these two individuals. A) Classical Ore-graph genealogical representation of the network boundary delineation. The two individuals in the household are circled in blue; we expand the boundary first to the green circle, including their first-degree civil kinship links (in this case, their parents), and then to the largest (magenta) circle which includes the new nodes' first-degree civil kinship links (in this case, the household members' grandparents, some of whom are deceased). By default, this process will also include several individuals not necessary for connecting the two household members (shaded), and may sometimes omit a relative who was not necessary for connecting the two household members (striped). Because our focus is on the relatedness within households, including or excluding external individuals does not change the analysis. B) Network representation of the boundary delineation. The two household members are now shown as blue filled circles (we no longer distinguish gender). Our kinship network first includes individuals in households, and is then expanded to include their first-degree civil kinship links (green circle) and their second-degree civil kinship links (magenta circle). C) Subsetting the network to only include individuals alive during a given time period, as shown in Figure 3. Because the two household members' grandparents are deceased (and therefore not included in this representation), the household members appear disconnected.

A note on network boundary delineation

In determining which nodes to include in the initial household network and this study's kinship network, we encountered the notorious network boundary problem, an issue raised by Laumann, Marsden, and Prensky (1989) and reviewed more recently by Marsden (2005). This problem of who to include in a kinship network in particular has been highlighted but not solved (Hamberger, Houseman, and White 2011), and kinship networks' inherent structures preclude the use of solutions using concepts of centrality such as n-cliques or k-cores (see Appendix C). Our solution made use of community-defined categories (household membership) and classical anthropological concepts (civil degree). Therefore, our definition of the nodes and edges (actors and ties) in the two networks in our study is "nominalist" in that we apply the predefined concepts of "kinship" and "household" to the community (though we meld Karanga definitions of the terms with externally-motivated definitions, these are not terms which originated with the community actors), "positional" in that we use membership in a household as an attribute-based way to determine inclusion of nodes, and "relational" in that we asked the actors themselves to describe household interactions, define household membership, and assess their relatedness to one another as well as self-reporting their genealogy (Laumann, Marsden, and Prensky 1989). Our method is therefore a blended approach as in Smith (2013).

We also point out that there is an inherent network boundary determined by the temporal limits of a study. This boundary is not often discussed, as typically a study takes place over a short enough time period for researchers to treat it as a "snapshot." In a longitudinal, multi-generational study like ours, the time boundaries are both broader and also more important in understanding the resulting networks and residence dynamics. For example, the genealogical process extends before and after the sampling period, and we may not include all parents or all children of every node in the sample. There may be artifacts in which we happen to catch households during periods of relative stability or relative change, simply due to the years in which the surveys were completed. Due to the community-based, mixed-methods approach we have taken, we are able to comment qualitatively on the behavior of the network beyond the unavoidably arbitrary start and end times of the surveys.

Quantitative analysis of household and kinship networks

Note that all references to "the kinship network" are referring to the partial network which included additional nodes such as deceased ancestors and out-of-area relatives. All analyses that refer to "households" are restricted to the individuals associated with or living in one of the sample households at a given sampling time. In analyses that refer to one of the four sampling times (1986, 1992, 1999, and 2010), we have only included individuals who were alive at those times. Visualizations of these networks were created in Gephi (Bastian et al. 2009).

Network calculations and high-network-degree nodes

Many computational and analytical tools have been developed for kinship networks, including testing the ability of marriages to create additional connections within existing genealogies ("relinking") by comparing against randomly generated kinship networks (Roth et al. 2013). Because our system has exogamous (outside the village/community) marriage, relinking marriages are less prominent, and because our motivation for the partial kinship network delineation was based on household membership, we do not pursue that analysis (White and Jorion 1996). We also do not report standard network metrics (e.g. clustering, assortativity) for the partial kinship network both because these parameters do not have meaningful interpretations for kinship networks (see appendix C), and also because these metrics are very sensitive to network boundary delineation (Kossinets 2006; Smith and Moody 2013). Rather than using those kinds of network metrics to represent our kinship networks, we comment on civil degree distances as defined above. To summarize our household networks, we list the number and size of households in each survey year, and the number of nodes in the partial kinship network. We comment on the network degree distribution of the partial kinship network in 2010, and test whether high-network-degree nodes tend to be household heads or tend to be male or female (using likelihood ratio tests using "lm" and "anova" in R (R Core Team 2014); see Supplements for R code).

Testing changes in "relatedness" (civil degree distance) within a household over time

As a metric of how closely related the individuals within a household are, we use the median of pairwise civil degree distances between individuals. By using the median rather than the mean, we avoid biasing the statistics when accounting for the occasional completely unrelated person in a household (where distance $= \infty$).

We statistically tested whether year, household identity (as a random effect), or household size could predict the median pairwise civil degree distance between individuals within that household. We used the R package "ordinal" (Christensen 2015) and the functions "clm" for the cumulative logit and "clmm" for a mixed model cumulative logit. We used an ordinal model because we had half-integer civil degree distances (when there were ties for the median). We tested year both as a factor (category) and as a continuous number. P-values given in Results are from likelihood ratio tests (see Supplements for R code).

Household location (spatial distance) and exchange of individuals

Studies linking geographical distance and migration and investigating its causes have a long history (Coombs 1978), and some studies show importance of different social networks at different spatial scales (Faust et al. 2000). Recent studies have addressed the integration of spatial and relational distance (Adams, Faust, and Lovasi 2012; Madhavan, Mee, and Collinson 2014) and some demonstrate a connection between kinship and geographical distance of residences (Verdery et al. 2012), using a kind of diffusion-based logic. One of the flexible strategies of households in Mazivhwa relates to resettlement in lands newly made available by the erosion of land ownership rights in the 2000s of mining companies in neighboring areas which were once part of tribal territories. There is therefore a spatial component to the movement of individuals between households, in which individuals may move short distances within Chinguo, or may move long distances to found households in former mining company land.

Using NetworkX (Hagberg et al. 2008), we investigated the importance of spatial distance on the flow of individuals between households by calculating a projection of the individual-household bipartite network, connecting households if they had ever shared individuals. We then located each household (based on the geographic coordinates of the kitchen or the front gate) using a Garmin eTrex 10 GPS unit and calculated inverse Cartesian spatial distances between households from these coordinates. We used inverse spatial distances in order to assign "zero" to the households which were so distant that their locations were not measured. Inverse distance also orients the variables to be potentially positively correlated under a model of diffusion: households with larger inverse spatial distance (smaller distance) should exchange more individuals, if diffusion is an important factor. In contrast, if inverse distance between households is not correlated with volume of individuals moving between them, we can suppose that distant resettlement is

just as important. We tested the relationship between inverse spatial distance between households and number of individuals in common between households using a Mantel test in the R package "vegan" (Oksanen et al. 2013), which generates p-values by permuting the two matrices. See supplements for R code.

Household change through time (change distance) and change in cattle holdings

Mcilvaine-Newsad, Sullivan, and Dougherty (2003) constructed a way to track compositional changes in households using kinship charts; however, we wanted to move away from classical-kinship-based definitions and constructions and therefore developed our own measure of household change not dependent on civil kinship. To quantify the amount of membership change in a household, we defined a "change distance metric" to apply to each household in each interval. Our change distance metric is defined to be the sum of the number of people who joined the household plus the number of people who left, over the given time period. This change distance metric operates on household membership sets analogously to the operation of "Longest Common Subsequence" distance metric (Navarro 2001) on strings (see Appendix D for details on change distance metrics). We selected this metric to accurately reflect the intuitive concept of a household's "change in membership": Each birth, death, emigration, or immigration is one change in membership.

We applied our change distance metric to each household over each of the survey intervals (1986–1992, 1992–1999, and 1999–2010) for which the household existed both at the beginning and the end. We use the term "change distance" to include all four types of membership change, and "migration distance" to include only emigration and immigration. In this case migration does not refer to physical movement of individuals but to whether they joined or left a household (recall that household membership includes individuals who can be physically distant but providing financial support). This allows us to determine the household change due to births and deaths in comparison with the change due to migration between households. We measure both types of change using our change distance metric, and calculate the change as an annual percentage of the household's starting population for each period. See supplements for Python code to calculate these metrics and Appendix D for details on the annualization calculation.

In order to assess how changes in household size were related to changes in household economic status, we calculated a parallel statistic to the one above for changes in

household size. This economic metric consisted of changes in the number of cattle held in the same households for the same time periods, assessed using survey and direct observation data on livestock holdings. Analysis focused on the six households that had been present throughout the time period.

Qualitative data

In addition to these quantitative analyses, in our results and discussion we include qualitative descriptions of the community's resilience, including broader trends throughout Mazvihwa and examples of particular households' responses to disturbances and challenges. These include 1) household flexibility, dynamism, and resilience, especially with respect to taking advantage of the opportunities presented by the resettlements; 2) a discussion of the importance of central/high-network-degree nodes (typically household heads), changes in civil-degree relatedness, and the impact of AIDS including the fostering of orphans; 3) a brief description of the richness of other social ties and networks in the community; and 4) reflections on the consequences of household dynamics for resource flows as an index of resilience. These examples and themes are abstracted and highlighted from the extensive interviews conducted by the community research team with the larger set of sample households throughout Mazvihwa Communal Area since the mid-1980s. They serve to give cultural context to our quantitative results, adding depth to the observations regarding the flexibility of household networks. These examples also reflect the diversity of strategies and networks employed by Karanga people in Mazvihwa.

QUANTITATIVE RESULTS

The partial kinship network has 403 nodes and 563 edges. The network degree distribution is heavy-tailed: over 300 of the nodes have fewer than 4 neighbors, while fewer than 10 nodes have more than 10 links (which is consistent with the structure of a kinship network in which neighboring nodes are limited to parents or spouses; see Appendix C). High-network-degree nodes (as calculated from the whole partial kinship network, up through 2010) are more likely to be household heads ($p \ll 0.01$), and are independently more likely to be women ($p = 0.02$, Figure 2). Because our kinship network is necessarily partial, these results are only suggestive. Some individuals may have higher network degree in the complete kinship network, but their relatives were not necessary to make them related to fellow household members and were therefore not included.
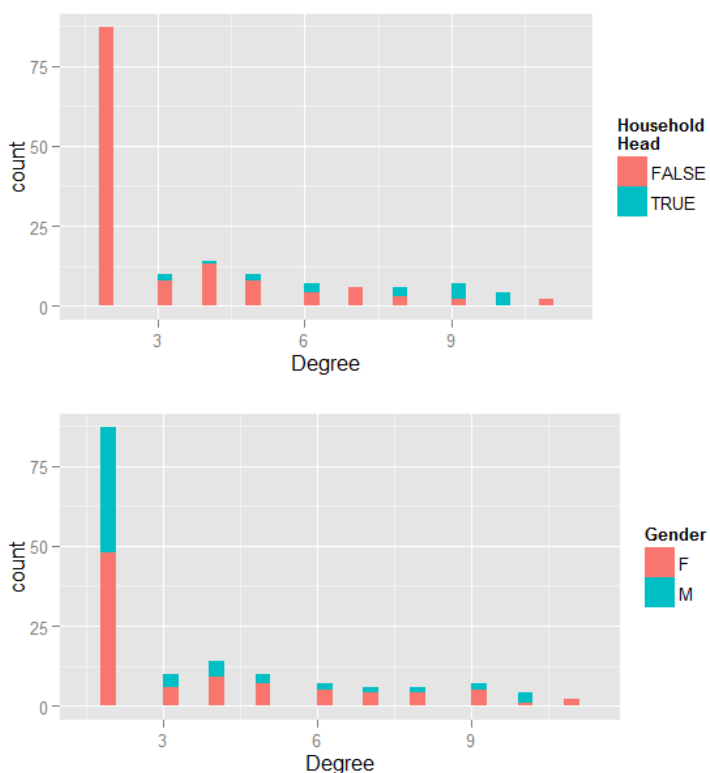
Figure 2: Network degree distribution of kinship network. Nodal degree broken down by household head status (top) and gender (bottom). Most individuals have nodal degree two, but it ranges up to 11. Household heads have higher nodal degree, though they are not the only individuals with high nodal degree.

There were more, smaller households over time (Table 1, Figure 3). Average household size was always larger than six individuals, contrary to the typical assumptions made by local aid agencies (which assume a household is six people), though the average is closer in recent years to this estimate.

Table 1: Household count and size over time

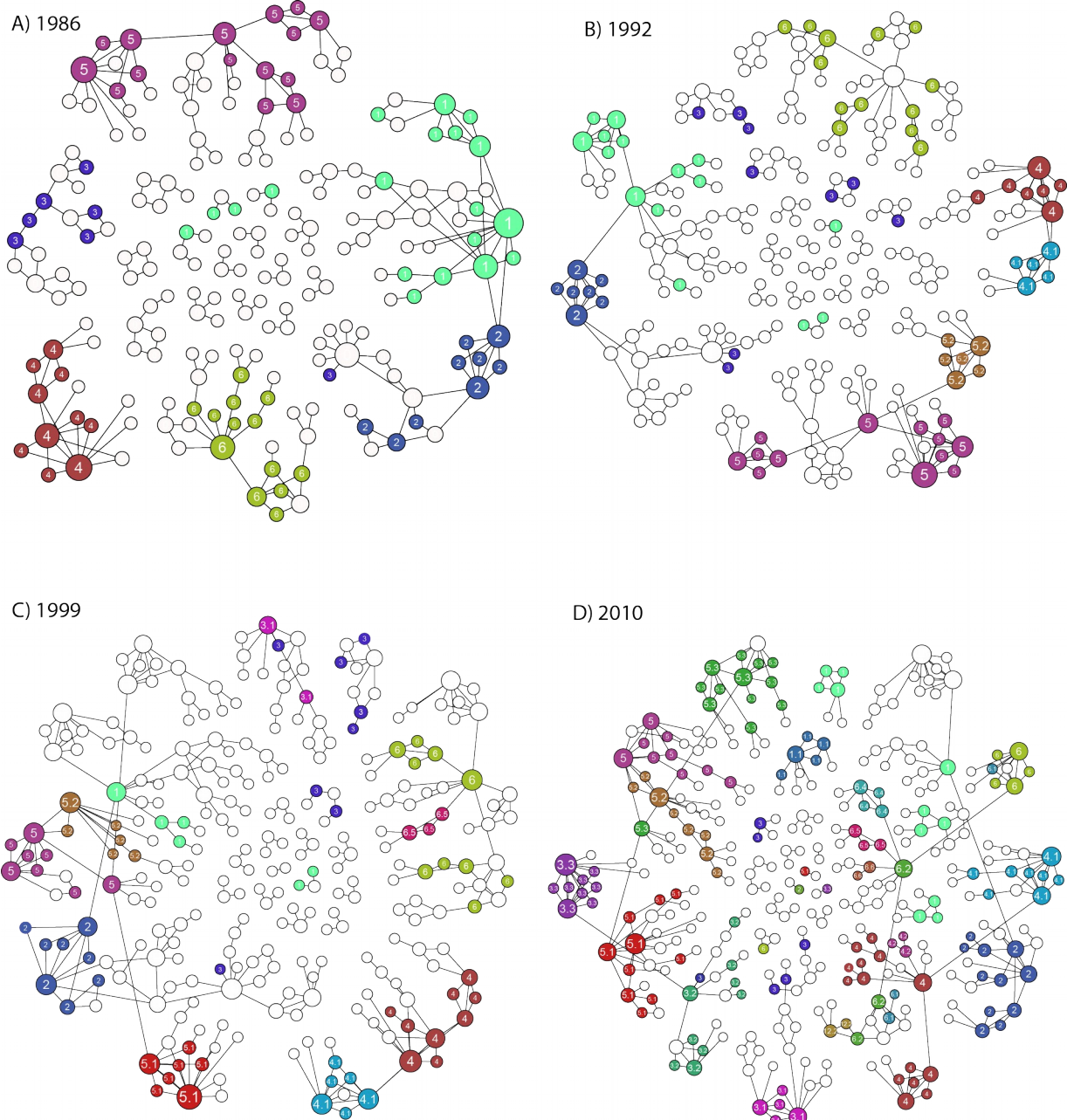| Year	Number of Households	Average Household Size
1986	7	10.5714
1992	9	8.4444
1999	12	6.1667
2010	23	6.4783

Figure 3: Partial kinship network in A) 1986, B) 1992, C) 1999, and D) 2010. Edges represent first-degree relationships (marriage or parent-child relationships). Individuals were included if they were alive at that time. Those with no color are not part of the sample households but are present to complete the genealogy in order to connect individuals within households who are related. Those who appear unconnected at the first civil kinship degree are connected to household members through individuals not alive in that year. Individuals in the sample households are labeled with their household number in each year. See also Figure 1.

The largest (non-infinite) minimum pairwise civil degree distance in the entire partial kinship network is 18 civil kinship degree steps (that is, among individuals who are related according to Karanga practice, the most distantly related individuals are 18 civil kinship degrees apart from each other). We know from the community's observations that nearly all individuals in these households, when taken together as a group, should be related within 18 civil kinship degree steps, with the exception of a handful of individuals. Therefore, the interview data confirms the network structure. Within each household, all members are related through the partial kinship network, with the exception of household 1 in the earlier two sampling times. Household 1 contained one "unrelated" person out of 20 household members in 1986, and in 1992 one out of 15 household members. These individuals, who were present as hired labor, were so distantly related that it was prohibitive to create the genealogy required to connect them – the members themselves simply stated that they were not related.

At the two earlier sampling times, the households all include individuals at least two civil kinship degrees away from each other, while in later years a few households consist only of parents, children, and spouses ("nuclear families"), which is consistent with the formation of new households by sons and their wives (see below). Note that the median pairwise civil degree distance in a "nuclear family" including only parents and children is one for families with five children or fewer, and two for larger families (see Appendix D for derivation). Though there are some nuclear families in Chinguo, this configuration is far from the norm: a majority (55%) of households (in all years) in Chinguo have median civil degree distances greater than two. Also, in those later years, other households include individuals many steps away from each other: in 1999 the largest minimum civil degree distance was seven steps, and in 2010 it was as much as 11. This is consistent with the practice of taking people in whose family and/or household circumstances had been disrupted, which we discuss in more detail below.

Statistical models of median pairwise civil degree distance

Household size is consistently a significant and positive predictor of median pairwise civil degree distance (p = 0.001). This result was consistent with both mathematical and cultural reasons to expect larger households to be likely to contain less related individuals:
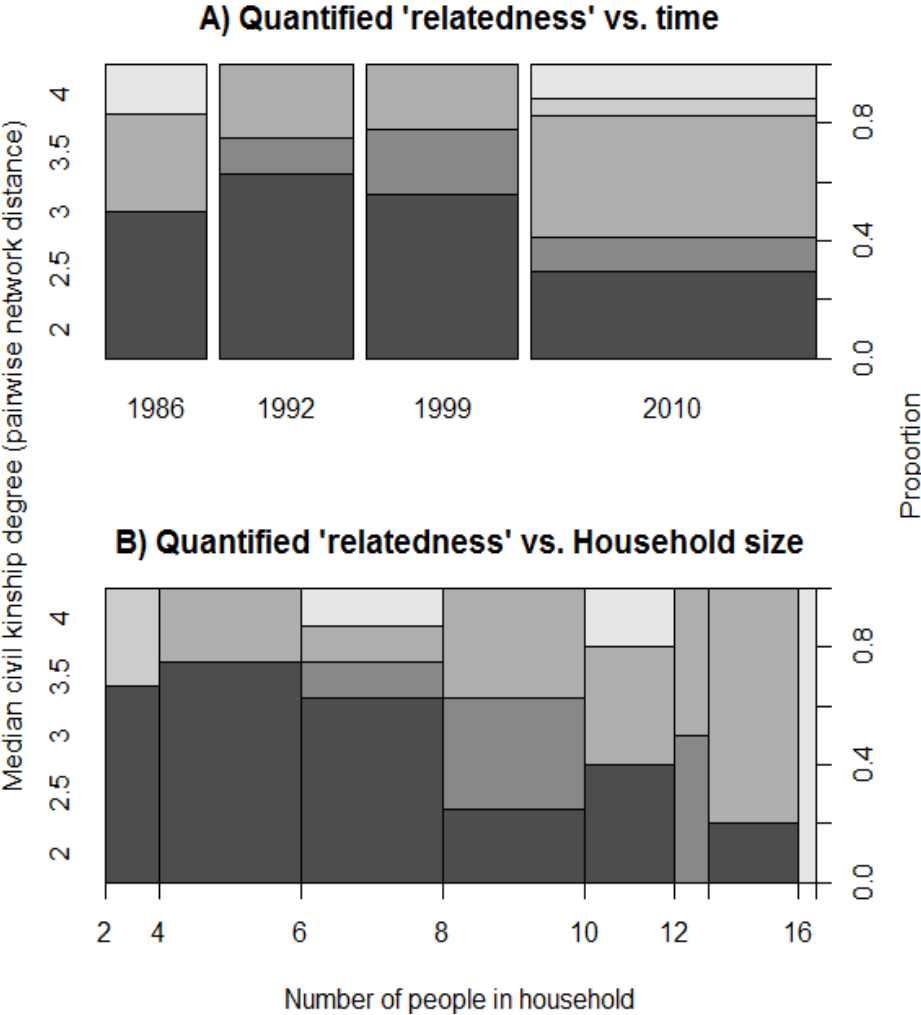
Figure 4: Spineplots showing the relationship between mean pairwise civil kinship network distance and A) sampling time, B) household size. The width of the bar indicates relative proportion of data points in that category (e.g. on the y-axis, categories are different median civil degree distances, which were 2, 2.5, 3, 3.5, and 4 civil kinship degrees; and on the x-axis were each of the four years, or a category-based representation of the number of individuals in each household), with the right-hand y-axis indicating a proportion adding to 100%. The x-axis indicates the categories of the independent variables, and the y-axis indicates the ranked categories of the dependent variable.

mathematically, with a larger sample of individuals, one is more likely to sample outliers, and culturally, we expect the larger households of established patriarchs to accumulate individuals from across the lineage. Year was a significant predictor of median pairwise civil degree distance (whether treated as a category or a continuous variable, p = 0.01),

with individuals becoming less closely related over time, confirming the visual pattern seen in Figure 4 and the tendency for more distantly related households to form after the years of crisis that the community has reported in interviews. Household identity (as a random effect) does not predict median pairwise civil degree distance (p = 0.2), but we retain it in our models while testing other variables according to good experimental design practices (Bolker et al. 2009).
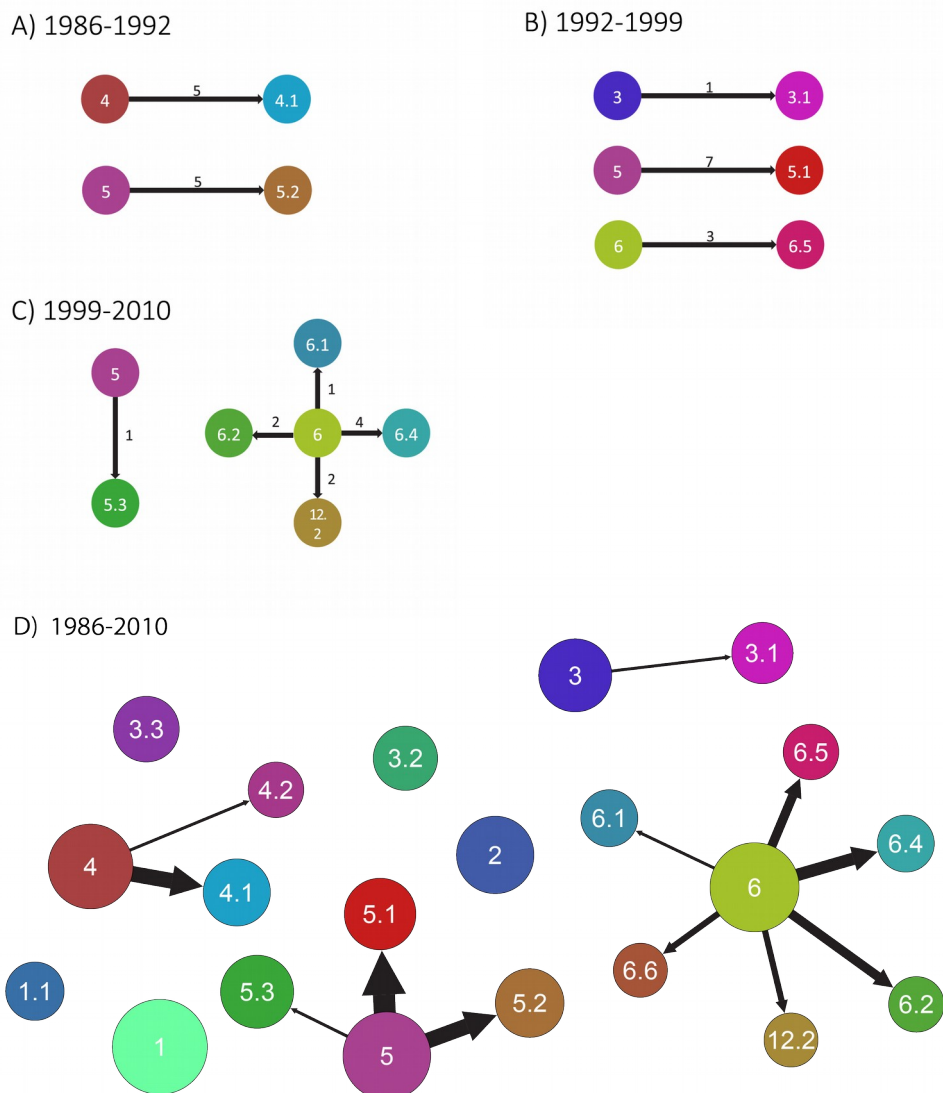

Figure 5: Household exchange of individuals from A) 1986 through 1992, B) 1992 through 1999, C) 1999 through 2010, and D) 1986 through 2010 (the entire period). In figures A-C, the number of individuals is indicated above the arrow; in figure D the thickness of the arrow indicates the number of individuals transferred. The colors match Figure 3.

Bipartite projection and mantel test of geographic distance

Households frequently exchanged individuals (Figure 5). Typically, smaller households split off from larger households as sons founded their own households or brothers decided to divide their late father's home. Looking at single time periods, individuals only moved from an existing household to a newly established household (Figure 5 a-c). Several households were stable over the 24-year period, exchanging no individuals with other households (Figure 5d). These were all households that had exchanged a few years prior to the arbitrary 1986 start date (between 1 and 2 and between 3 and 3.2 and 3.3), and several did after the 2010 cut off also (e.g. 1 and 1.1), reflecting the effects of the arbitrary time bounds of the analysis; but this phenomenon does demonstrate that there can be periods of stability for individual households. Prior to 1940 the ancestors of the heads of all these households were within a single household; we started to observe them in the mid-1980s by which time they had differentiated into six surviving households after two major cycles of change (including the death of the patriarch of the second generation). There were many cases of individuals leaving the community for some period of time and then returning to a different household when they later rejoined (Figure 5d), a phenomenon not visible in the individual time periods (Figure 5 a-c). Inverse geographical distance did not predict household exchange of individuals (Mantel statistic "r": 0.06575, p=0.11).

Household change through time and related cattle holdings

Of the households with change that we could measure (those present during at least two surveys), household composition was very dynamic (Table 2). Every household changed composition in every period, and cases of small amounts of change were rare. (Raw mean household composition change was 81.3%; annualized mean household composition change was 6.9%.) The majority of change results from emigration/immigration rather than births/deaths. While some households had little or no migration in some periods, and care must be taken to account for the unequal lengths of survey periods, it is clear that on average migration between households greatly alters the composition of households. (Annualized mean household composition change due to migration between households accounted for 4.5% of the total 6.9% annualized mean household composition change.)

Comparing changes in household size against changes in number of cattle held (a key productive asset and a strong proxy for economic wellbeing, see Appendix A), during the

three time intervals for the six households continually present demonstrated an interesting relationship (Figure 6). Every case of growth in net household size was associated with an increased cattle holding. Most cases of reduced household size were associated with reduced cattle holdings (exceptions will be discussed under qualitative findings). This suggests decisions to join and leave a household are actively associated with its changing level of means.
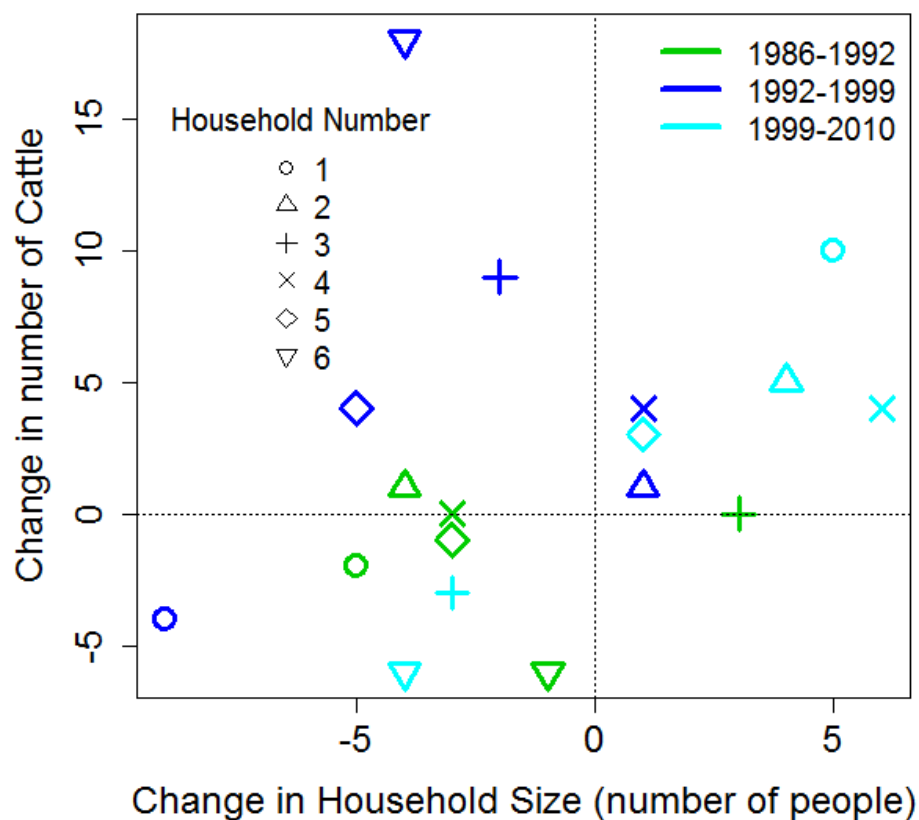

Figure 6: Change in cattle holdings with changes in household size in the 1986–1992, 1992–1999, and 1999–2010 periods for the six households present at all four survey intervals.

Table 2: Births, Deaths, Emigration, and Immigration for each household in each time period

HH Num	Period	Start HH Size	Change Dist	Change %	Birth	Imm	Em	Death	Migr Dist	Migr Change %
1	86-92	20	9	45.0	+0	+2	-6	-1	8	40.0
	92-99	15	9	60.0	+0	+0	-9	-0	9	60.0
	99-10	6	11	183.3	+4	+4	-2	-1	6	100.0
2	86-92	11	4	36.4	+0	+0	-4	-0	4	36.4
	92-99	7	1	14.3	+1	+0	-0	-0	0	0.0
	99-10	8	8	100.0	+5	+1	-2	-0	3	37.5
3	86-92	7	5	71.4	+1	+3	-0	-1	3	42.8
	92-99	10	4	40.0	+1	+0	-3	-0	3	30.0
	99-10	8	9	112.5	+2	+1	-5	-1	6	75.0
3.1	99-10	3	5	166.7	+3	+2	-0	-0	2	66.7
4	86-92	11	9	81.8	+1	+2	-6	-0	8	72.7
	92-99	8	3	37.5	+2	+0	-1	-0	1	12.5
	99-10	9	8	88.9	+7	+0	-0	-1	0	0.0
4.1	92-99	6	2	33.3	+1	+0	-1	-0	1	16.7
	99-10	6	5	83.3	+3	+1	-1	-0	2	33.3
5	86-92	16	9	56.2	+3	+0	-6	-0	6	37.5
	92-99	13	9	69.2	+1	+1	-7	-0	8	61.4
	99-10	8	7	87.5	+3	+1	-3	-0	4	50.0
5.1	99-10	7	9	128.6	+6	+1	-2	-0	3	42.8
5.2	92-99	6	2	33.3	+1	+0	-0	-1	0	0.0
	99-10	6	7	116.7	+4	+1	-2	-0	3	50.0
6	86-92	15	9	60.0	+3	+1	-4	-1	5	33.3
	92-99	14	12	85.7	+1	+3	-8	-0	11	78.6
	99-10	10	16	160.0	+1	+5	-10	-0	15	150.0

QUALITATIVE RESULTS AND DISCUSSION

We have observed that the community in Mazvihwa, including the village of Chinguo, have been resilient in the face of many significant challenges (for further evidence for this see Appendices A and E). There are many reasons for this resilience, which include a diversity of livelihood strategies, local and international migration and long-distance financial support, agricultural and livelihood innovations, and the opportunities provided by the resettlement of neighboring former commercial ranch/mining lands. Close attention to survival strategies, however, indicates that how people flexibly manage their familial and household relationships has also been crucial. Below, we explore in more detail some of the social-network-related aspects of this flexibility.

Dynamism of household change and resettlements

This study demonstrates the extreme fluidity in household composition over time, with average turnover in composition between survey periods of over 80%. This fluidity is largely the product of migration (namely people moving from one household to another) which accounts for twice as much change as births and deaths, the factors usually implicitly assumed dominant in the models of households as "natural" family assemblages. This ability to migrate between households and form new households is evidence of the flexibility of households in this community. Such flexibility shows how individuals and groups can adapt to new circumstances like the new land available for resettlement, enhancing the resilience of the system to remain in a desirable (economically and socially stable) state.

Dynamism means simple static models of households are not useful

In addition, our observation of the dynamism of household networks emphasizes that simple, static models of households are not useful in Mazvihwa, which has implications for the community and for those who would seek to aid them. This means that assessments of households at one time period which assume that the same individuals will be present at the next time period and that their well-being is related to that of the household (e.g. Mushongah and Scoones 2012) are significantly flawed. It is already well accepted that "high rates of circular migration and fluid household and social relationships" characterize communities such as these (Hosegood et al. 2005) and therefore simplistic models of population-household-wellbeing relationships do not hold for cross-sectional surveys.

Instead, analysis needs to document the dynamics of both individuals and households.

Flexible ways households are created and reabsorbed and flux of individuals

Two areas of flexibility are particularly apparent in this study of how kinship networks interact with household boundaries. The first is that large numbers of individuals, typically those who leave for urban areas across Zimbabwe and the region, chose not to remain within the sphere of influence of their rural kin but instead distance themselves from household obligations in their natal villages (and sometimes certain kin relationships) for large periods of their lives, only to return in the face of old age or misfortune to try to fit back in (Household 1.1 is a good example of this; having returned with no assets it subsequently failed and joined Household 1). Marriage breakdown or widowhood can lead to a return to the natal household (or to that of a more suitable relative), or to their moving into a different household as the inherited spouse of another member of the patrilineage, or to their remaining as the matriarchal household head, gradually or rapidly handing over to her youngest son who likely remained in his father's home for this eventuality.

The second is that large numbers of people at any particular point in time do not live with their closest relatives and instead choose (or are chosen) to be members of other households in the village. Importantly in relation to both points: how individuals affiliate in any one-time interval is likely to change later in life. These changes reflect decisions made and attitudes expressed by household heads and other powerful figures in clan and kinship networks, but also the choices made by the individuals themselves. In Karanga culture even children have some rights to request to live for periods of their lives in other households, and often do. Childless couples and grandparents have claims on the children of others to fill out their homes, as well illustrated here in Household 3 whose diverse assemblage of children appeared to outsiders to comprise a normal nuclear family. Poorer relatives and orphans will find themselves distributed according to the means to support them and the need for child labor for herding and domestic work. Sons or brothers may choose to team up to create a large extended household for a while; or to divide up as a way of claiming sites and lands further from the natal home as happened here in Household 5. Such issues drove a large proportion of the noted 80% plus changes in composition in the years between surveys.

Scales of dynamism within households, within villages, and outside villages

Dynamism acts both within individual households and across several larger scales. At the broadest scale, the economic crisis in Zimbabwe and the breakdown of commercial land rights have seen around 25% of individuals abandoning Mazvihwa as their home residence, to establish or join households in resettlement areas or urban areas in Zimbabwe or overseas, where around 34% of new households emerging have been created since 1986 (Figure F1). At a finer scale, households themselves open and close and change leadership, with the individuals who comprise them being born, dying or migrating to other households: only 36% of the original households sampled in Mazvihwa still had the same household location (Figure F1) and head in 2010 (the amount in Chinguo village was 33%). And within these households a changing proportion of people choose to be absent from those households as labor migrants of various kinds, even as they still call those households home; this figure has ranged from 24-36% between 1986 and 2010 depending mostly on the strength of Mazvihwa's economy, with higher rates of absence during the 1992 drought and financial crises of the 2000s (K.B. Wilson, unpublished data).

Social forces pushing households apart and keeping them together

Many changes in household composition reflect the eruption or resolution of social conflicts, with key people choosing who they wish to share space with and taking their dependents with them. These conflicts often follow existing tensions within families, such as between the children of different wives, competitive or jealous brothers, or difficulties between wives and their mothers-in-law. The community has cultural practices to soothe those tensions, for example, to deal with actual or potential conflict between wives and their mothers-in-law, a big household will formally grant her autonomy and control of her own new and separate kitchen and domestic space through the process of "*kutegeswa.*" Families often make great efforts to keep together, particularly at the site of the original major household, around the cultural value of *ivhu rinofara* which refers to the desire to keep the "soil happy" by remaining in the place where your ancestors are (for example, where your grandfather is buried). Many Karanga emphasize that the coherence and success for a family or household is deeply impacted by its relationship with ancestral spirits. The desire to maintain ancestral harmony motivates individual and group efforts to overcome conflict and to therefore retain options for people as to where to reside over the course of their lives. In fact, at times the assets of a deceased patriarch, the *nhaka* – especially livestock and arable land – are not distributed through the usual *kugadzira*

inheritance ceremony for many years so as to keep the household together under the control of his widow. This is what happened with Households 1 and 6 both of which persisted after the passing of the two most powerful figures in Chinguo social network. The comfort experienced in Karanga culture around the dead still being part of the lives of the living thus provides the option of maintaining continuity in a household even with the passing of its owner and unifier.

Spatial dynamics and the opportunity presented by resettlements

Though many people desire to retain their access to households located in the natal area, there are also high returns for both individuals and the kinship network of securing access to additional land in new areas. The Chinguo household cluster is descended from an individual who left a defensive hill around which productive land was limited and owned by a few, to occupy space in what was the early twentieth century land frontier (in a region where access to a variety of soil types conveyed significant advantages in relation to seasonal and inter-annual variability, Wilson 1990). Similarly, current households are taking opportunities to stake claims in the ancestral territories of their chiefs that were held as private commercial ranching land by mining companies during the colonial period and recently became available to small holders under the creative chaos of the "fast track" land resettlement programs since the 2000s (Scoones 2010). Both this factor and the cultural practice of sons creating their own households explain the observations that smaller households split off from larger ones (Figure 4a-c). As individuals migrate between households in their natal areas and those being established on these new lands, it is not surprising that spatial distance alone is not a good predictor of the flow of individuals to and from different households, as shown in the Mantel test. It is also not surprising that membership of these new households has been particularly unstable since conditions there are unpredictable and access to services such as schools generally inadequate. Underlining how these reflect how opportunities open up, individuals mostly move from existing households to new ones, rather than between existing households.

Influential individuals, relatedness, and AIDS

One finding of this study is that households themselves are not the only or most informative unit of analysis to understand the community's resilience. We do therefore consider the impact of influential nodes (typically individuals who have been in the community a long time, have more than one spouse, and many children). We note that

high-degree nodes can be either men or women. Some of these are household heads, and some of these are spouses of household heads. Some are even women household heads: household 6 was one of the most successful in the cluster, reflecting how well a powerful widow and her daughters managed their inheritance and found systematic strategies for maintaining their livelihoods and autonomy. This reflects the fact that although Karanga social structure means that people join households as part of the husband's clan, in fact many individuals also join households because of their family relationship to a powerful wife. It is possible that when both a husband and wife who run a household have unusually large networks, they themselves are redundant leaders, serving to keep those households together and perhaps even stabilize them in the event of the death of one or other leading member. Thus households' resilience and persistence may depend on the identities and combinations of key nodes.

Households are of course vulnerable to the life cycles of their leading members, however well placed they are economically. Thus was the fate of the wealthiest household in this cluster in the 1980s. This was that of the eldest descendant of Chinguo who sustained the largest cattle holding and established a large family beyond that with his wife. He had become an effective patriarch building a large household around his family that included a number of illegitimate offspring of his daughters who came of age during the liberation war in the late 1970s. In addition, he also held sway over the households of his nephews and cousins (as much as his sons), and oversaw relationships with a long-standing subservient clan, the Ngwenya (Crocodile), whose households still abut his own without even a fence between them. With his passing in the 1990s his own household passed into a period of poverty and was apparently set to dissolve (although it was later to rally and recover somewhat), when no other member of the immediate clan was able to establish similar authority in the village despite much effort, with two poles developing around the heads of Household 3 and Household 5.

Disruption of networks due to loss of important nodes from HIV/AIDS

As elsewhere in the region, adult mortality from HIV/AIDS has been high in Mazvihwa with nearly half the men and over a quarter of the women born between 1946 and 1975 dead by 2010 (Appendix F). This wave of mortality has disrupted the leadership of several of the households here discussed, and led to the hosting of children orphaned in the wider kinship network, and the return of some widowed daughters to their natal villages. This need and ability of people to find new residences away from their natal families is the

main driver of the decrease in relatedness (as measured by the median civil degree distance) observed within households over time. Only by understanding the persistence of these kin-based relationships and responsibilities can we understand how these individuals accessed resources and support in their time of need.

After an AIDS death, the question of residence for a household's members brings on active negotiations. One of the earliest victims of AIDS in this area was the young household head of Household 5.2. His widow successfully negotiated maintaining a separate household while accepting a traditional form of wife inheritance ("*kugara nhaka*") by the head of Household 5 with whom she bore further children. The family did well, although she was not able to maintain the cattle herd. This case can be contrasted with another of the Chinguo women who returned home from Gokwe on divorce from a less favorable situation (also connected to HIV-AIDS) to establish household 5.3 but was unable to secure the assets or support necessary to flourish. Therefore individuals' varying access to resources, social and otherwise, still has an effect on their ability to be individually resilient to crises.

Fostering of AIDS orphans

One dimension of household flexibility which has attracted particular attention in Africa is child fostering. Data from surveys in different countries finds that, independently of AIDS, from 15% to 37% of households include children living in households other than those of their biological parents and that up to 28% of children live in such households at any given time (Akresh 2008). The reasons for this have been demonstrated to include advantages to both sending and receiving families and to individual children, appear facilitated by the quality of social networks, and include resilience in response to shock events (Akresh 2008). These findings are mirrored in our study community. There are four HIV-AIDS orphans (defined as being below twenty years of age and having lost both parents, or having lost the mother where the child is illegitimate) in this social network. One was already 18, the younger of two illegitimate brothers who was orphaned in 2002 by the loss of their single mother, who had remained a key member of her parents' important household. This orphan therefore remained in that household with his grandmother and faced minimal disruption. The other three AIDS orphans were all taken in by their relatives from outside of the Chinguo social network (as defined here) as single young children with their siblings shared among other relatives. One was taken in by his uncle, one by his mother's sister, and one by the sister of her grandmother; all the

receiving households were of average wellbeing. This illustrates the ease with which children can find support in households with whom they share matrilineal or patrilineal relationships beyond the immediate social network of their parents.

There was no recorded case in this social network – or the wider sample in Mazvihwa – of failures to get such support resulting in child-headed households (these are rare in Zimbabwe and typically the result of disputes that ruptured social support networks in ways that made any assistance given to them somehow socially illegitimate, see Roalkvam 2005). Other studies indicate that caring for AIDS orphans is a strain for Zimbabwean families, but that many families are willing to foster individuals outside their kinship network (Howard et al. 2006), and this has indeed happened in Mazvihwa, though not in this particular social network. Educational and welfare outcomes for these orphans have not yet been assessed in relation to how they are situated in households and social networks, but recent studies in other African countries indicate the potential for orphans to have lower educational attainment in southern Africa (Malawi: Hampshire et al. 2015) and overall outcomes (Lesotho: Goldberg and Short 2012, Kenya: Nyambedha, Wandibba, and Aagaard-Hansen 2003), where kin support is typically inadequate (Nyambedha, Wandibba, and Aagaard-Hansen 2001).

Diversity of networks

This community's diversity of social support structures include several networks independent of relatedness and residence. People use these other networks to further achieve resilience in times of need, illustrating the power of redundancy in a context where it cannot be clear who can best help in the face of changing circumstances.

Clan networks

Clan relationships beyond blood relatives remain important, as do the reciprocal ties with the families and lineages with whom wives are exchanged in neighboring or distant villages. It is these relationships that the Chinguo cattle holders use when drought strikes, because some of them live in the Baradzamwa region where natural wetlands and "miombo" woodland food resources can help keep cattle alive in bad times. The bonding that happens between a dominant and subordinate clan, whose members accept the honorable title of *vaTogwa* (in Chinguo these are the Crocodile clan of the late head of Household 4) both reflects and continues opportunities to seek and provide patronage.

Another patronage relationship, usually operating outside of family relationships, is the livestock loaning system known as *ronzera,* through which the stock-rich reduce herding labor and risks of loss by making long-term loans to individuals in other areas who get to keep a share of the offspring. For example, household 4 was able to access *ronzera* cattle in the early 1990s from someone unassociated with his usual patrons, and therefore able to start to build his own herd. But in contemporary Mazvihwa there are also now newer kinds of association that people use to connect and address opportunities and adversity.

Church networks

In recent decades there has been a significant growth in both church membership and in the number of denominations in the wider community (growing from eight in 1986 to twenty-two in 2010; see Appendix G). There is much evidence from interviews and observation that the churches in the 2000s encouraged increasing economic, cultural and social engagement of their members in the kinds of activities previously provided by households and lineages. Zionist and Pentecostal churches deeply engage their members, and, as if in response, the older Mission churches had also developed much stronger group identities, especially for their women, with uniforms, more regular meeting and close collaboration the norm. Interviews and observations in Mazvihwa over these years indicate that the diversification and intensification of religious affiliation largely reflected the struggle to deal with affliction and vulnerability during the years of economic chaos and mass mortality. As such, the churches have been playing a pivotal role in supporting resilience in a number of dimensions, materially as well as spiritually, and, in reference to the themes of this paper, these churches expanded the potential social networks available for people beyond kin and household. These organizations created safe space where individuals feel they can share their problems and generate solutions. In those difficult years (and especially at the lowest point in 2008) many felt the country's problems reflected a national spiritual crisis, so religious practice was also about restoration and healing at a group level, and sometimes in ways that concretely linked people to international movements and material assistance from relief agencies as well as their local peers.

Cooperative gardens

There has also been growth in non-governmental organizations and economic associations (like cooperative gardens) in Mazvihwa, especially among women. Cooperative gardens are

groups of one dozen to two dozen members that the government allows to establish micro-irrigated plots near rivers and streams. These enable women to produce nutritious and marketable foods through social networks outside their households, establishing assets and connecting independently to wider economic processes. As such, they enable women to build social support systems to complement those from their homes, and so again enhance resilience for individuals and their children, including the possibility of attracting investment by aid organizations. These gardens can have elaborate governance systems where women express leadership and develop organizational skills. Women in these groups find that not only do the community gardens provide additional food security (especially for those living with HIV/AIDS), they provide another environment in which to discuss problems and gain social and emotional, and problem-solving support.

Local Non-Governmental Organizations

Among local organizations impacting community resilience the local group now known as The Muonde Trust is particularly significant. Muonde is a community-based non-governmental organization which grew out of the research effort that created the data featured in this paper and brings together large numbers of people in the Mazvihwa area (including from the Chinguo social network) to provide a platform for sharing knowledge and generating commitment outside of traditional lineage and village structures. This enables Muonde as a group to discuss complex issues, such as gender, and enables people to build social networks across the villages. Central to Muonde is support of indigenous innovation around such issues as water harvesting, agro-ecological innovation, woodland management planning, and improving domestic architecture. Muonde consciously expands access across this community to practical innovations being undertaken by others within Mazvihwa and neighboring communities, such that experimentation and learning are diversified and accelerated. By democratizing participation in this process, and putting the emphasis on supporting women, Muonde creates opportunities to reach the previously marginalized. In other parts of Africa, non-governmental organizations aimed at helping farmers adapt to climate change have favored men over women (Perez et al. 2015), so a local NGO which can help both men and women provides a wider support structure.

Implications for flow of resources through the community

As noted above, the productive assets essential for economic success are not owned at household level but by individuals within the leadership of those households. The three

most important of these assets are arable land, livestock (especially cattle), and educational qualifications. Below we explore the way these resources flow through the social networks we have described previously.

Land, Education, and Cattle

Family histories indicate that except where new land is obtained from headmen, agricultural land is primarily acquired by individuals through inheritance or allocation by the "shallow patrilineage", namely not from one's father but from one's uncles, grandparents and great uncles. Meanwhile most woman-owned land pre-dates colonial government intervention in the 1950s and early 1960s and was obtained from headmen and patriarchs, especially in polygynous situations. Widows often retain use of their late husband's lands, especially those best connected and considered able to continue household function. Women typically give land to favored sons in their old age, as part of creating a stake in the household they have chosen to live.

Livestock, meanwhile, can be purchased from salaries, informal work and crop harvests, but most significant livestock herds were in part originally inherited, usually from parents. Presence of livestock enables accumulation of food supplies and other assets so that even when livestock are lost in droughts previously stock-wealthy households typically bounce back. Livestock are owned by individuals and are much used beyond the household, in that people may pool available animals across social networks (again typically the shallow patrilineage) to create draft-animal teams over the course of a season that work sequentially on fields associated with different households.

Educational investments are made both by parents and by comrades in the shallow patrilineage, though in this case it is typically the role of those recently completing education (or holding down good salaries) to pay for younger siblings and nieces/nephews. In short, each of these main assets – and often the lesser ones – is not managed long term at household or nuclear family level, but instead involves reciprocal flows or long-term patronage across social networks and between households, mainly between individual men who are one to three civil kinship degrees apart but of the same clan.

Relationships between household composition and numbers of cattle

A dynamic relationship between household assets and household size can be expected if

households are embedded in social networks in which people truly exercise choice. If household residence is not a given, and personal wellbeing is at risk, more people should be joining households better positioned to meet their needs and they will be increasingly likely to leave households that are declining. Although little-investigated in the literature, there is evidence for such relationships elsewhere in Africa. Ranchhod (2009), for example, reports changes in household composition through inter-household migration in South African households following the loss of key pension earners who typically serve as the breadwinners for the poorest households in that region. In our system, household membership is fluid and levels of livestock assets are quite variable in the face of drought and other misfortune, so households should be more likely grow in size when livestock numbers are also growing, and to decline when livestock holdings decline. Figure 6 indicates that in every time period when a household increased in size, it also saw an increase in cattle numbers, while decreases in household population size were slightly more frequently associated with decreases in cattle holdings. Meanwhile it is notable that in the 1992-99 and 1999-2010 periods there appears to be a clearer trend than in 1986-1992 when severe drought at the end of the time period was killing cattle in all households independently of changes in size. Note that, from interviews, we know that increase in cattle numbers precedes increase in household members, lending strength to the idea that individuals are joining households which are more successful.

Further analysis of reasons for decrease in household size when cattle numbers were growing revealed that these apparent anomalies were mainly the result of household divisions during periods of rapid stock growth. Thus of the four cases where growth in cattle numbers was associated with declines in household size, two involved the successful birthing of new households with their own cattle (3.1, 5.1) and a third involved the imminent break-up of household 6 into several households which was preceded by the departure of several adult members in search of opportunity in new lands. This dynamic relationship between household size and assets indicates how decisions to join and leave households generates responsiveness to household assets and the ability of people to find what they need from household membership.

CONCLUSIONS AND FUTURE WORK

From a methodological standpoint, the combination of quantitative network analysis with qualitative ethnographic descriptions has proven itself able to make visible aspects of the interplay between relatedness and residence that were otherwise difficult to see due to

their complexity, in the spirit of White and Johansen (2001). We were able to visualize and analyze temporal change as well as understanding the cultural realities underlying it, including seeing how cultural ideas of relatedness play out to ensure that few people are truly left behind through repeated crises. By defining relatedness broadly, this culture enables a diversity of relationships to support individuals in times of need, and by supporting the flexibility of many networks (both within and beyond kinship), the community enhances its resilience in the face of challenges.

At the same time, this study of kinship networks, residence, and household dynamics has highlighted the known challenge of persistent patriarchy in the community, and the role that patrilocal marriage and bride-wealth payments have in maintaining it. Resilience is indeed possible for potentially undesirable states as well. If patriarchy concentrates the resources and decision-making power that people find necessary for well-being, then we can view the household as a location of patriarchal power that individuals may wish to escape. From that perspective, the decline in household size that began in the early twentieth century and continued during the three decades of this study is a sign that more individuals can access resources and find support through other kinds of social networks. Perhaps successive crises have even made people more aware of the pathways to resilience they can access. The way in which women, in particular, have been using the social networks of community-based organizations – including churches – to organize, share ideas, and meet their needs, bodes well for the future.

The village of Chinguo was selected for pilot study as a representative microcosm of what is happening in the region more generally (as observed by the community research team of The Muonde Trust). The methodologies explored here therefore show promise for further application to this wider society. Future combinations of ethnographic and network analysis could inform us about the effects on social networks and households of more recent developments – for example, indigenous innovations in the farming system and the spread of mobile digital technology. Future work could use more sophisticated models to include more of the networks in the village (e.g. include church affiliations and combine household and kin relations) as bipartite multilevel social networks (Lomi, Robins, and Tranmer 2015), incorporating the temporal dynamics of these networks and their interactions. Hierarchical statistical models have a history of use in ecology to represent structure in data, e.g. spatial autocorrelation (Royle et al. 2007; Finley, Banerjee, and MacFarlane 2011) and multiple sources of variation and missing data (Eitzel et al. 2013, Eitzel et al. 2015). These models show promise for multilevel network analysis (Slaughter

and Koehly 2016; Sewell and Chen 2016).

Finally, we believe it is noteworthy that both the quantitative and qualitative data used in this study, especially that at the individual level, could only have been obtained accurately with a long term participatory approach, because most of what was happening in these households would not be revealed by standard survey methodology. This enabled the mapping of individuals as they relocated from household to household over a 25-year time span, a task which would have been impossible for an outside research team. The reason this community has engaged in such fine-grained work over a generation has been primarily to uncover and support indigenous ways to improve livelihoods and environmental assets. This work is important to the community because external efforts seem so unable to understand local dynamics or find transformative intervention points. Local action-research helps this community tackle "donor syndrome" (relying on outside resources for wellbeing) and through their own process of inquiry they can develop their own capacity to understand resilience and enhance sustainability. This approach has in turn been made possible by the continuity of Dr. K.B. Wilson's engagement in their area. The use of the community's high-fidelity data for research in this paper and others like it is a new development based upon trust and a growing interest of the community in telling their own story to the outside world, even if this sometimes means compromising communication by using academic language and complex mathematics. As co-authors as well as activists for an indigenous development model, they hope this engagement in scientific communication can be achieved without turning them back into colonized objects for study and vulnerable to top-down recommendations for improvement.

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APPENDIX A: EVIDENCE OF RESILIENCE IN MAZVIHWA VIA INCREASING
WELL-BEING OVER TIME

Infant and child mortality rates were calculated through constructing complete fertility
schedules for 497 women from a stratified random sample in Mazvihwa through repeat
discussions of that woman and other family members by trusted interviewers as well as in-
person observation over the 1986-2010 period. Some 32 of these schedules were not used
because of concerns about completeness or reliability. The supposed collapse of
Zimbabwe's economy, health and education services, on-going droughts, climate disruption
and environmental challenges, and the massive HIV-AIDS pandemic, were collectively
unable during the late 1990s and 2000s to reverse the decline in infant mortality, and led
to only a modest increase in child mortality (Figure A1).
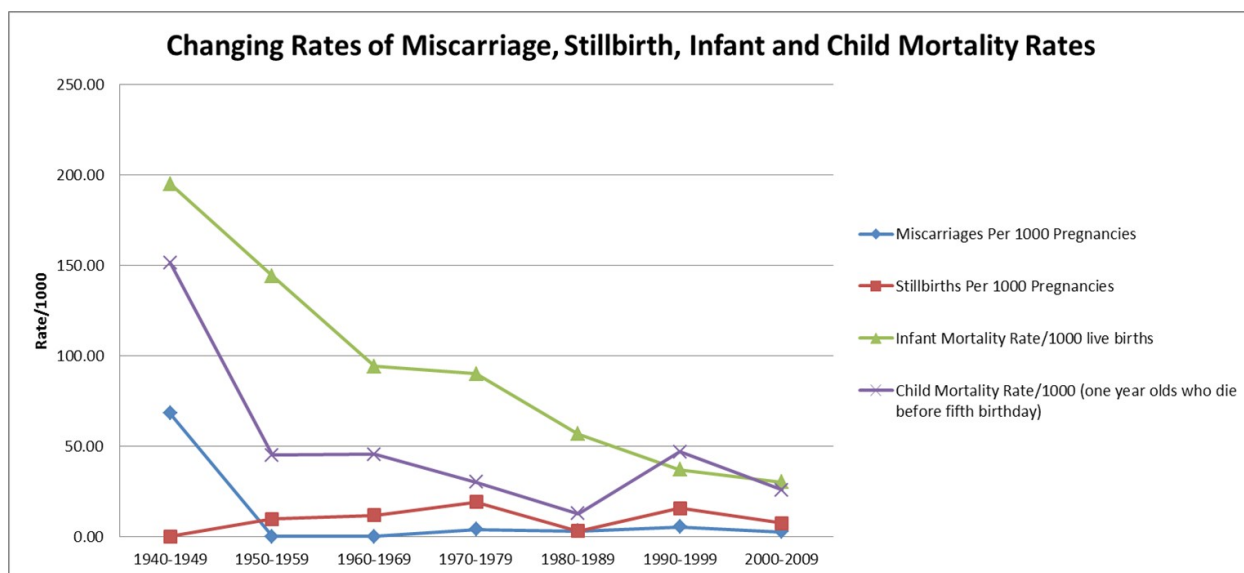
*Figure A1: Decreasing child and infant mortality over the period from 1940 through 2009
from interview recall data and direct observation.*

Asset ownership was obtained through interview of members of a stratified random sample
in Mazvihwa by local interviewers at three time intervals, 1986, 1999 and 2010, recording
(and/or observing) the assets held in each household (Figure A2). People in Mazvihwa
have been able to sustain their level of agricultural equipment over time while also
acquiring increasing electronic goods. Further data from this sample shows that, over this
same period, the number of huts per person has nearly doubled, and the number of rooms
in houses has trebled per person, indicating how people have also been able to increase the
physical assets of their homes despite these crises.
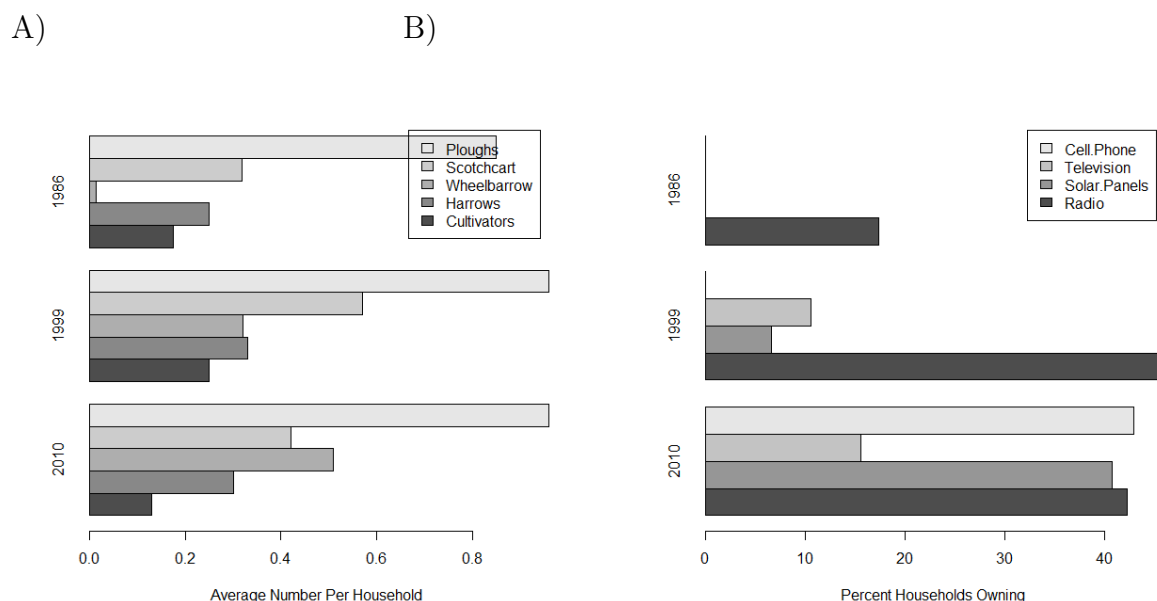
A)   B)

Figure A2: Assets over time: A) agricultural equipment in number per household and B) proportion of household owning various electronic goods (right)

Cattle are the most important productive asset for people in Mazvihwa; in addition to their value for meat and milk, they provide the most important inputs to dryland agriculture (draft power and manure), and cattle provide an excellent savings option, with a high rate of return and good liquidity, although of course also high risk in relation to losses in severe drought. Additionally they play an important role in *lobola* or compensation to a bride's family upon marriage, reflecting the ability of young men to start their own families. Changes in cattle numbers were assessed by interview and direct observation at each survey interval in the Mazvihwa sample households, determining which individuals owned each animal at that time. The numbers of livestock, and especially cattle, increase over the time of our survey period (with a decrease in the number of goats; Figure A3). This growth has been achieved through a complex interplay between reduction of cattle mortality in drought years and democratization of establishment of cattle herds, with informal economic activities enabling the purchase of stock outside of household-based agriculture largely controlled by patriarchs. Since this has been achieved on lands already considered heavily over-stocked, changes are underway in both how people manage grazing and in how they invest in assets (K.B. Wilson and A. Mawere Ndhlovu, in prep.).
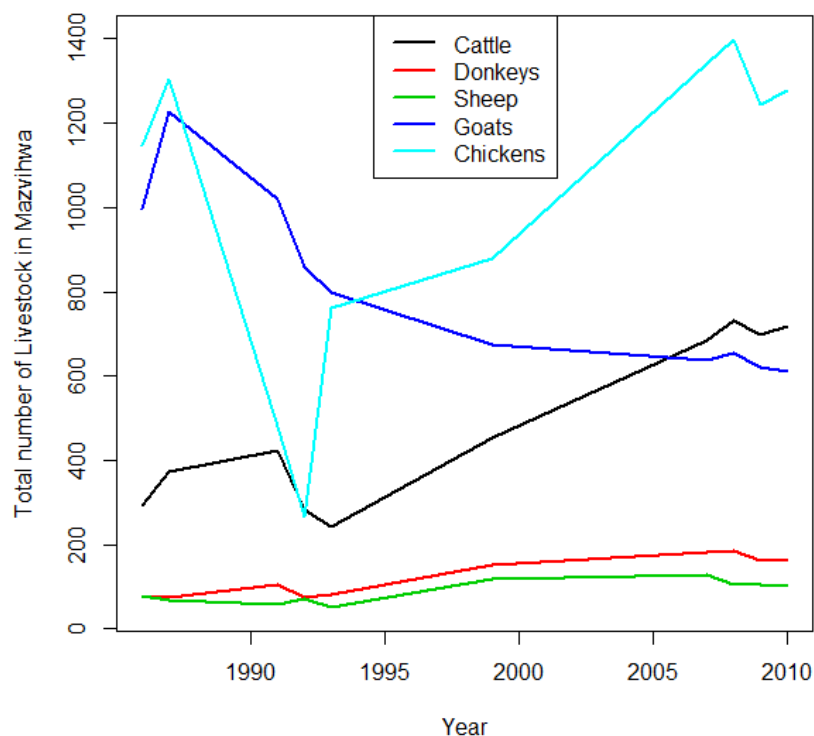
Figure A3: increasing cattle production over time, with other livestock mostly increasing as well (with the exception of goats). Note that the drought in the 1990s strongly affected most livestock.

APPENDIX B: COMMENTARY ON TRADITIONAL INTERPRETATIONS OF "KINSHIP" AND "HOUSEHOLDS"

Comparative study of kinship was an early founding concept for anthropology, but was strongly criticized as being Euro-American-centric (Schneider 1972, 1984). Recent work is much broader, including power relations, gender, individual human agency, and influences of the state (Peletz 1995, Stone 2002). Recent work questions the biological basis of kinship (Sahlins 2012; Parkin 2013) and allows for definitions of kinship to be based in the culture being studied (Carsten 2000; Bamford and Leach 2009). Regardless of these criticisms, historical terminology persists. We use some of that terminology in this paper, but we use it critically: we describe the specific ways in which we employ it, and present it alongside a broader set of culturally-embedded definitions and descriptions. In the

context of sustainability, we see this as part of a social and epistemic justice project.

Households are a similarly problematic idea. Households as a concept have been studied as far back as Aristotle (Keyt 1987; Cain 2010) and are a common unit of study and analysis in evaluating social and economic wellbeing in rural communities in "developing" countries (Naude et al. 2012), but more recently, even in western industrialized societies, questions have been raised about definitions of family and household (Wilk 1991; Bien, Marbach, and Neyer 1991). Though the household is often seen as a self-evident unit (Netting, Wilk, and Arnould 1984), they can appear quite different in different studies, necessitating flexible definitions (Niehof 2011). Though households in some African cultures can be quite strongly defined and kinship can determine to some degree who helps whom (e.g. the Pimbwe in Tanzania, Kasper and Borgerhoff Mulder 2015), decision making within the household is not unanimous (Vivaya et al. 2014) and households often defy enumeration efforts in censuses. This can be especially frustrating for international comparisons when different countries define households differently (Guyer 1981; Randall et al. 2015). In particular, more flexible (and potentially dynamic) households may defy this kind of census (e.g. in Tanzania and Burkina Faso: Randall et al. 2015; South Africa: Kriel et al. 2014; Mali: Beaman and Dillon 2012). Careful definitions of residency in a household can strongly affect results (Gödecke and Waibel 2015). Kinship and residence are often much more complex than can be represented in a database, and ethnographic as well as demographic analyses can each benefit from the other in clarifying what is happening (Reynolds 2015). We prefer a more open definition of households (Souvatzi 2014) but quantification requires us to define both household and kinship. We describe our definitions in quantitative terms that make use of historical anthropological ideas but also explain cultural definitions of relatedness and residence, moving to embrace both quantification and ethnography simultaneously.

APPENDIX C: NETWORK BOUNDARY PROBLEM AND NETWORK METRICS FOR KINSHIP NETWORKS

The field of network theory provides many techniques commonly used in basic network analysis, such as computing the network's assortativity (tendency to connect nodes of similar degrees) or clustering coefficient (extent to which nodes' neighbors are connected to each other). Such metrics are meaningful in many types of networks, including some of the most commonly studied types, such as online social networks, telephone call networks,

or citation networks. However, the more structure imposed on a network, the more constrained its shape becomes, and the more complex it becomes to extract meaning from these basic network statistics. Any two people could be Facebook friends, or could call each other, or (assuming they both publish research) could cite each other, so basic network statistics help describe the high-level structure of these minimally-constrained graphs.

However, kinship networks are highly constrained graphs, with specific structural forms that differ from the types of networks described above. The prohibition on directed cycles (no one can be their own ancestor) creates a partial ordering, agreeing with our intuition that the concept of "successive generations" make sense for a kinship network. Traditionally, it is common to designate multiple types of nodes (such as male and female) and multiple types of edges (such as parentage and marriage). When using this concept of ancestry, we gain the additional restriction that each node has in-degree 1 from each gender. It is common for co-parents to be married, and while this is hardly universal, it adds structure to many kinship networks in many cultures. (See Hamberger, Houseman, and White 2011 for further discussion.) Furthermore, kinship networks have a hidden dependence on time: Not only do they evolve over time like many networks, but individuals have a date of birth and therefore an age, and reproduction is age-dependent. Most importantly, unlike in many other networks, it is rare for a node in a kinship network to link to most types of its neighbors' neighbors (e.g. spouses' spouses, or descendants' descendants; except for common links to one's child's parent, or equivalently to one's spouse's child), which inhibits formation of cliques and similar structures. The result is that a typical kinship network does not look like a typical network in recent social networks analysis: its connections do not follow a power law, a node's neighbors' neighbors are rarely adjacent to the original node, and the network's directed acyclic graph structure suggests its underlying flow from ancestors to descendants. With this inherent structure, extracting high-level meaning from a kinship network's assortativity or clustering coefficient becomes muddy.

Furthermore, in spite of recent research on the "network boundary problem," the question of delineating the boundary of a kinship network poses a separate set of challenges due to the inherent structure described above. Simple techniques such as identifying fully connected subgraphs (cliques) fail to delineate a realistic boundary, even in unstructured real-world networks. Because of this, more sophisticated boundary identification techniques have been defined, e.g. n-cliques (Luce 1949), n-clans (Mokken 1974), k-plexes

(Seidman and Foster 1978), k-cores (Seidman 1983), and more sophisticated solutions to the boundary problem have been proposed incorporating these techniques. (e.g. in Freeman 1992, Scott 1991, and Doreian and Woodard 1994). However, boundary delineation techniques based on a concept of centrality (including n-cliques, k-plexes, k-cores, etc.) tend to work best on unstructured networks, and fall prey to the inherent structure of kinship networks. For example, a couple with one child appears to be a very solid component, because every node (person) is directly connected to each of the other two – in contrast to a couple with many children, where the path from any child to any other child is of length 2, making them appear more loosely connected. However, large nuclear families are often more important, rather than less important, in a kinship network. Qualitatively, this suggests the reasons why different boundary delineation techniques should be used when working with kinship networks. Many additional structural factors confirm this, such as the strong tendency of a node's neighbors' neighbors (e.g. children's children) not to be connected to the original node, due to incest taboos. Mathematically, this results in an irregular, but generally small, clustering coefficient (dependent on the number of children in the family).

In our specific application, we can define a useful network boundary while avoiding theoretical complication. Since we are interested in the structure of the kinship network which allows us to see how two people who describe themselves as related are in fact connected to each other by descent and marriage, we can simply start with the set of people who describe themselves as related, and augment the starting set of nodes with sufficient additional people – ancestors, spouses, etc. – to demonstrate a path of connectedness, and then confirm that the path is of the appropriately minimal length (e.g. confirm that we haven't identified the pair as distantly related on one side, when they are also closely related on the other side) through interviews.

APPENDIX D: BACKGROUND AND DERIVATIONS OF METRICS

Background on household change distance metric

Our metric of change in household membership can be interpreted as the Jaccard distance (Jaccard 1901) scaled by the household size. In contrast, a metric such as Levenshtein distance (Levenshtein 1965) would count the death of a small child and the birth of a new child within the same time period as a single "change" in children, which is not a useful

measure of social groups in this context. Navarro (2001) provides a summary of distance metrics in the context of string matching problems in computer science; the primary differentiator between metrics for letter membership in strings vs. human membership in households is that households have no defined ordering and therefore no possibility of transposition.

Also note that for households which only appeared once in the surveys but exchanged individuals with households which persisted for two surveys, the change in individuals is only half-counted in the overall change in the system. This means that the change in aggregate is a conservative estimate.

Derivation of annualized household change

Since an annualized rate of change of a implies that an initial value v leads to a value of $v \cdot a$ one year later, the value after t years is $v \cdot a^t$. However, the distance metric does not reflect a final value v_f, but rather an amount of change. This is analogous to, but not equal to, $v_f - v_0$, since one birth and one death yield a distance metric of 2, but in that case $v_f - v_0$ would be 0.

Therefore, given an initial household population of v_0 and a distance metric d (either total household change distance or household migration change distance), and a time interval of t years, we have:

$$d = v_0 \cdot a^t - v_0 \tag{D1}$$
$$d = v_0 (a^t - 1) \tag{D2}$$
$$d / v_0 = a^t - 1 \tag{D3}$$
$$1 + d / v_0 = a^t \tag{D4}$$
$$(1 + d / v_0)^{1/t} = a \tag{D5}$$

In the results, the value d / v_0 is given as a percentage (either "change" percent or "migration change" percent).

Derivation of median civil kinship degree distance for "nuclear families"

The nuclear family is a dominant Euro-American family structure. To highlight the diversity of relations and models of "family" in Karanga households, we calculate the

median civil kinship degree distance for a nuclear family as a comparison. If we define a nuclear family as a family containing only one pair of parents and their children, we can calculate their median civil kinship degree distance in closed form. First, in a family with only spouses, children, and siblings, civil degree is either one (parent-child or spouse-spouse) or two (siblings). Therefore the median degree is either one or two, which is already smaller than the median degree of most households in Chinguo.

Specifically, the number of children at which the sibling links outweigh the parent-child links/spousal links is six. We derive this from the following logic: the parents always contribute one spousal one-degree link; they contribute one one-degree link each for each child; and the number of sibling relationships is based on the triangular numbers. So, if N is the number of children, the median becomes two when:

$$[(N-1) + (N-1)^2]/2 > 1 + 2N \qquad (D6)$$
$$N^2 - 5N - 2 > 0 \qquad (D7)$$

From the quadratic formula, N > 5.37 or N < -0.37. Throwing out the negative root, the first whole number of children larger than five (i.e. six) is the trigger of going from a median of one to two.

APPENDIX E: CHANGES IN LOCATION AND LEADERSHIP FOR HOUSEHOLDS IN MAZVIHWA COMMUNAL AREA

The current locations and the identities of the household heads of all households in the Mazvihwa sample were recorded, including both the original 69 households in the whole sample and the households which were created from them since 1986. This data was obtained through regular interview of descendants still resident in Mazvihwa, of the owners of these new households when they came to Mazvihwa for vacations and funerals, and through direct visit or cellphone contact with absent people. While two thirds of the households generated are still in Mazvihwa, the rest are scattered across a wide variety of locations, especially in resettlement areas of various kinds and in urban locations elsewhere in the region (Figure E1). Over a third (36%) of households have remained in the same location with no change in leadership, while 15% relocated and over half (52%) had changes in leadership (Figure E2).
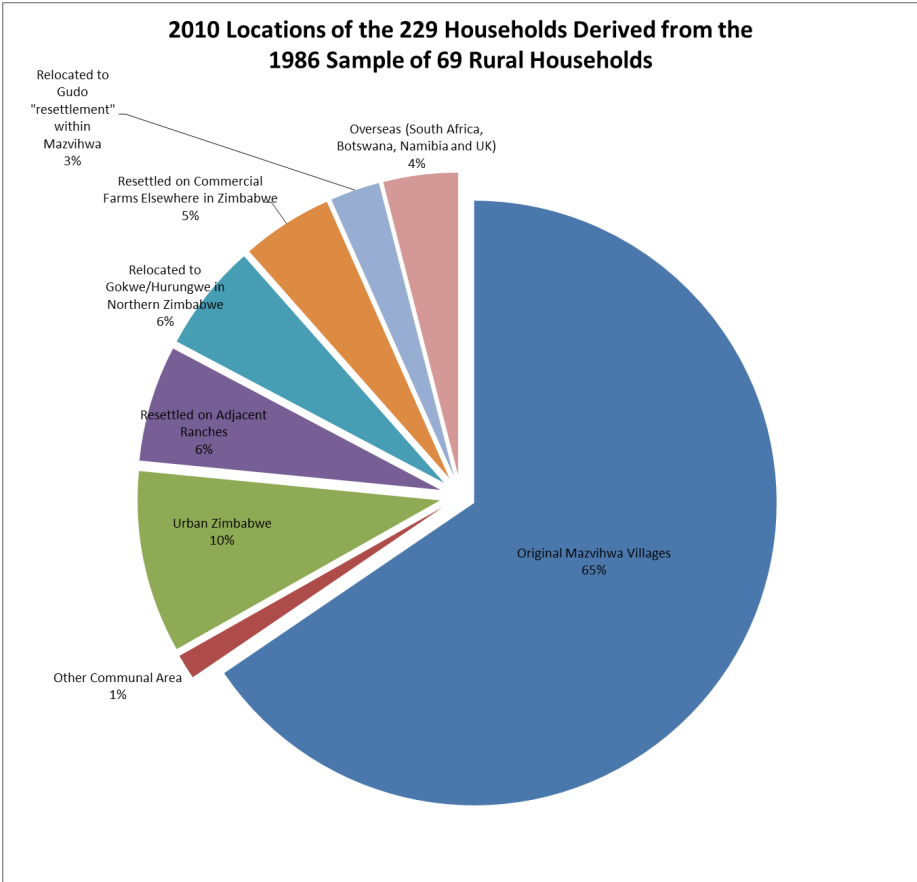
Figure E1: 2010 locations of original households and those derived from them. "Ranches" and "commercial farms" refer to land formerly owned by mining companies.
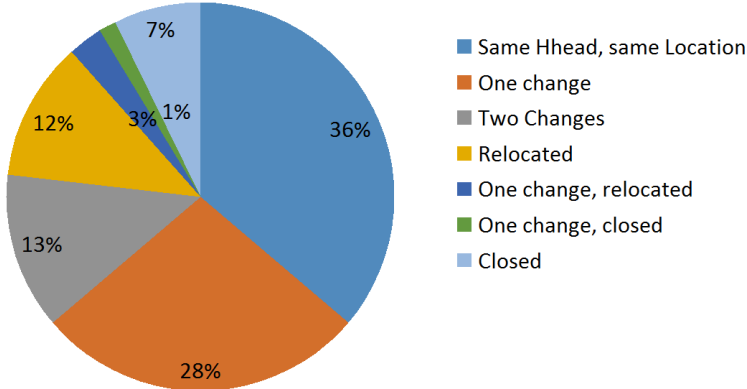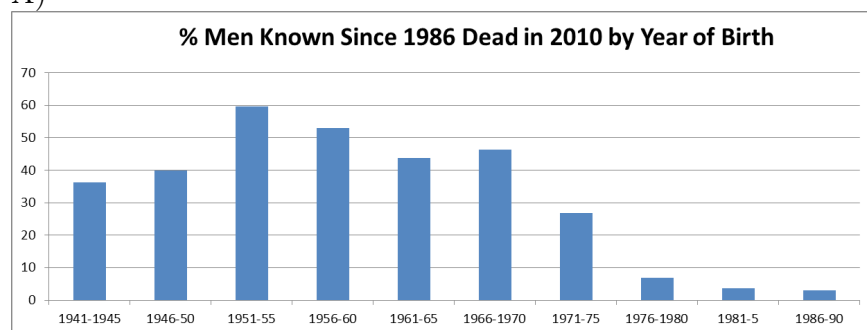

Figure E2: Changes in household leadership and location for households in Mazvihwa from 1986 to 2010. "Change(s)" refers to changes in household heads over time, while "relocated" refers to the entire household moving to a new location. "Closed" refers to a household which dissolved, with its members finding other homes.
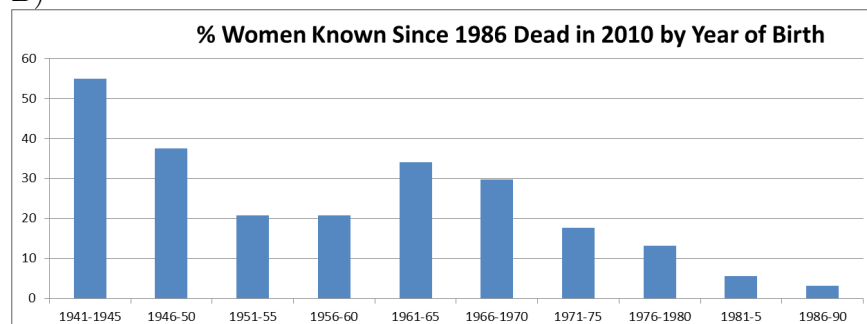
APPENDIX F: MORTALITY IN ADULT POPULATION DUE TO AIDS

Adult mortality data were assembled through prospective observation by local interviewers of known individuals of known ages during the time intervals investigated in a stratified random sample in Mazvihwa through the 1986-2010 period. There were 328 men and 472 women in the sample who were between 20 and 69 years at some point between 1986 and 2010; uncertainty over the fate of 21 men and 22 women meant they were excluded from the analysis. Overall mortality rates were therefore assessed from a total of 5468 live person/years for men and 7,037 live person/years for women in the 20-69 age group; the field researchers recording a total of 68 male and 65 adult female deaths of individuals aged 20-69 years over this 1986-2010 time period. Figure F1 demonstrates how substantial adult mortality has been during the time period, and while medical assessments of the cause of death were not undertaken, it is clear more than 80% of this mortality was directly AIDS-related.
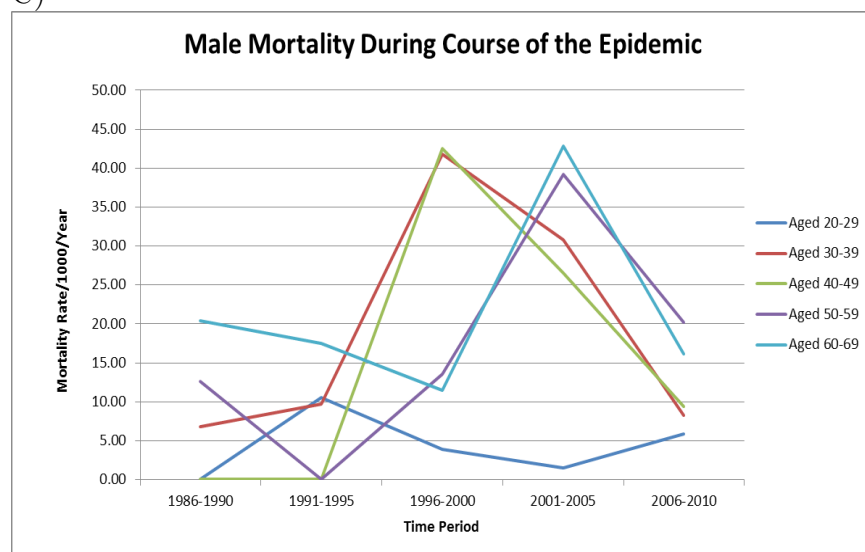
A)

% Men Known Since 1986 Dead in 2010 by Year of Birth

B)

% Women Known Since 1986 Dead in 2010 by Year of Birth
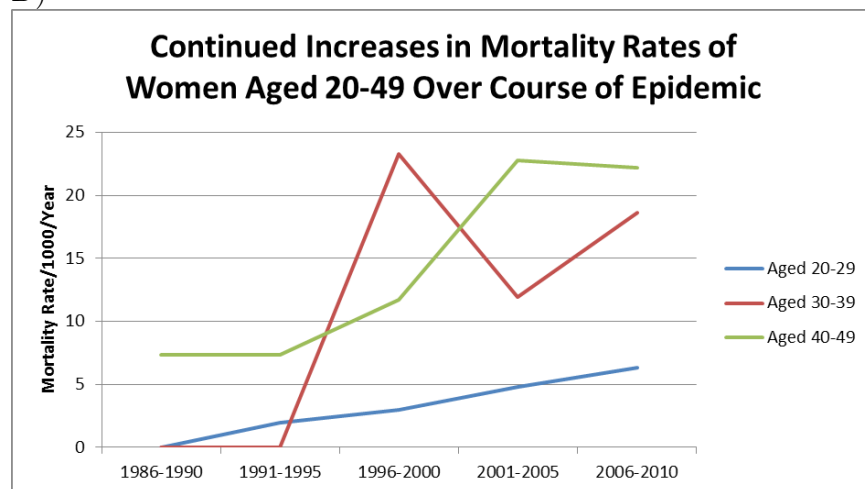
C)

D)

Figure F1: Mortality with time due to the AIDS epidemic. Age structure of mortality for A) men and B) women known since 1986. Higher than expected proportions of men age 35-56 and women age 30-50 have been dying, likely due to AIDS. Mortality rate over time for different age categories of C) men and D) women. The lower two graphs more clearly show the pulse of mortality in the early 2000s, again in particular in men age 30-49 followed by those 50-69 and in women age 30-39. Most troubling is the increasing rate of death in young women age 20-29.

APPENDIX G: CHANGES IN RELIGIOUS AFFILIATION OVER TIME

Religious affiliation was obtained through interview of members of a stratified random sample of samples in Mazvihwa by local interviewers at three time intervals, 1986, 1999

and 2010, recording religion of each household member. Because households often had members practicing more than one religion the total is above 100%.
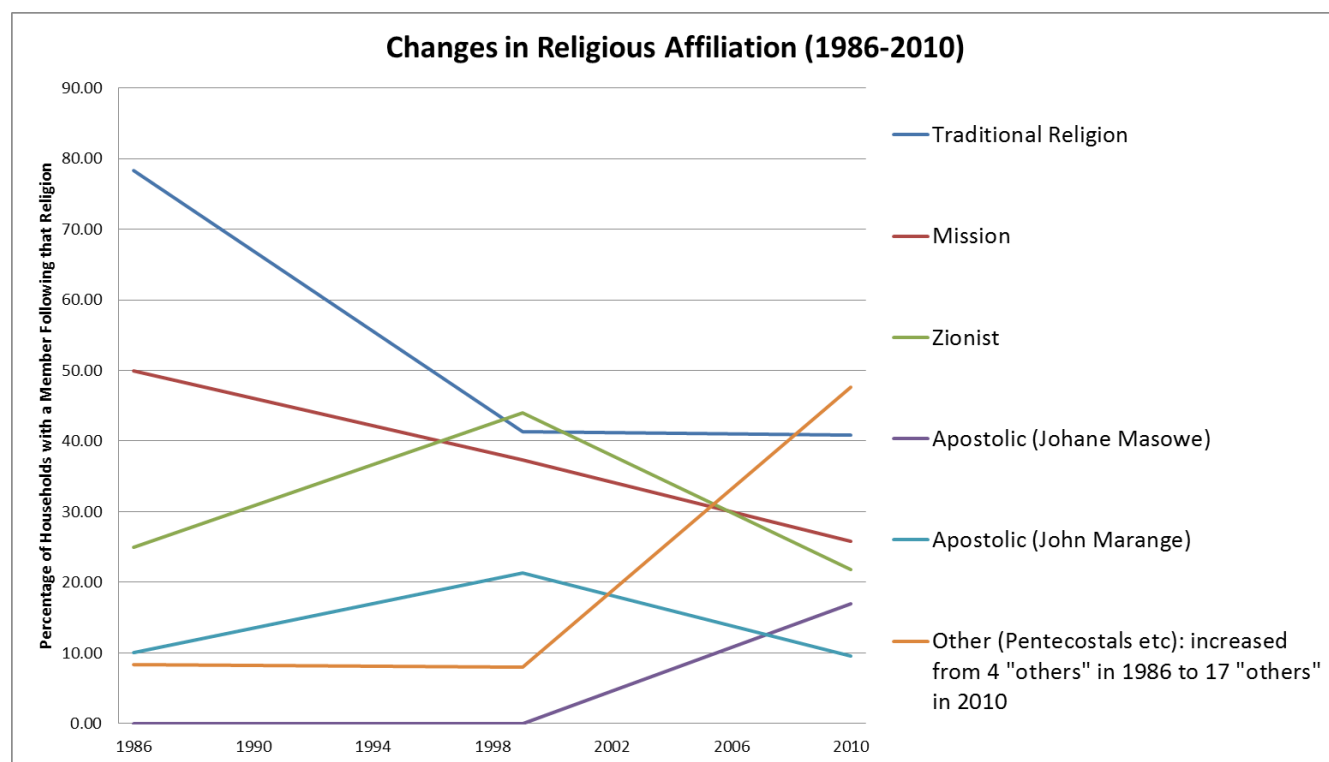

Figure F1: Changes in religious affiliation over time from 1986 through 2010

This pattern of diversification in churches also occurred within the Chinguo social network, where in 1986 four of the six households were headed by people who said they followed African traditional religion, but in two of those households there were also women and children adherents of Mission churches (Lutherans and Church of Christ), with the Lutheran churches being followed by the other two households in entirety. By 1999, four of the then-nine households had committed themselves to an established, but expanding, independent African church called "Zionist", the rest remaining Traditionalist or Mission Church members as before. However, it was during the crises of the 2000s that we saw big change in religious affiliation in Chinguo: four new Pentecostal (or similar) churches arrived and found adherents alongside the existing faiths from 1999, and nearly half the households were now of mixed religious affiliation (it was 22% in 1999).

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