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Abstract

Natural disasters impose high and lasting psychological costs, yet the distribution of these costs within households remains poorly understood. Using a unique panel dataset of couples in Malawi, this paper examines the effect of Cyclone Idai damage on couples' mental health. We find that female spouses experience a 5.65% erosion in self-efficacy five to seven months after the cyclone, while their husbands show no significant change. We find no significant effects on depression or stress-related disability for either spouse. To explain this gender divergence in self-efficacy, we investigate differential access to labour market coping strategies. Following severe cyclone-related losses, husbands are 14.5% more likely to engage in wage employment and report 26.8% higher wage earnings relative to husbands in low-loss households, whereas wives' participation in income-generating activities remains unchanged. Together, these findings show that the psychological effects of the disaster are gender-differentiated within the household, and differential labour market opportunities may explain the divergent psychological outcomes observed between spouses. These patterns have implications for the design of disaster response and social protection policies.

JEL Codes: D13, D15, Q54, I10, I30, I32

Keywords: Natural Disasters, Mental Health, Intrahousehold, Gender, Labour.

1 Introduction

Natural disasters impose enormous costs on human welfare. Between 2000 and 2019 alone, they affected more than four billion people worldwide (UNDRR, 2020), and with accelerating climate change, both the economic and human toll has risen sharply (IPCC, 2023). Newman and Noy (2023) estimate that extreme weather events attributable to climate change caused average damages of USD 143 billion per year over the past two decades. However, these costs are not borne equally; while natural hazards do not discriminate by level of economic development, their consequences do. Richer countries experience fewer disaster-related deaths and recover more quickly, while poorer countries bear a disproportionate share of the long-run burden (Kahn, 2005).

Beyond their immediate economic and physical effects, natural disasters carry significant psychological costs. The public health literature documents elevated psychological distress, anxiety, and depression among disaster survivors (e.g., Maruyama et al., 2001; Frankenberg et al., 2008; Amstadter et al., 2009; Rataj et al., 2016). These effects extend beyond clinical symptoms: disasters also depress subjective well-being and aspirations (Rehdanz et al., 2015; Ahmadiani and Ferreira, 2021; De and Thamarapani, 2022). This matters for recovery because poor mental health is not merely a byproduct of disaster, it can itself impair the ability to work, make decisions, and participate in recovery activities (Nan et al., 2025; Orkin et al., 2024; Carvalho et al., 2026). As a result, psychological and economic recovery are jointly determined.

Yet, despite this growing literature, most studies estimate average population-level effects, and causal evidence across distinct dimensions of mental health remains limited. Important within-household dynamics remain largely unexplored. While a broader literature documents that shocks affect men's and women's assets, labour, and welfare differently (Quisumbing et al., 2011; Kumar and Quisumbing, 2014; Erman et al., 2021; Fruttero et al., 2024), we know little about how a shared disaster differentially affects the mental health and recovery of women and men within the same household. Understanding these intra-household differences is crucial, as variations in mental health effects could shape overall household resilience and long-term recovery outcomes.

Using a two-year panel dataset from the districts of Mangochi and Nsanje in Malawi, collected in 2018 (pre-Cyclone Idai) and 2019 (post-Cyclone Idai), we examine the impact of Cyclone Idai-related damage on intrahousehold spousal mental health and labour market coping behaviour. Cyclone Idai, one of the strongest tropical cyclones ever recorded in the Southern Hemisphere, affected over 975,600 people in Malawi, causing widespread displacement and extensive housing damage, with estimated economic losses of USD 220 million (Government of Malawi, 2019, 2023).

To estimate the effects of the cyclone on mental health, we exploit variation in households' self-reported cyclone-related losses, following an established literature that uses household-reported shock exposure to identify the welfare effects of disasters (Dercon et al., 2005; Heltberg et al., 2015; Arouri et al., 2015; Deuchert and Felfe, 2015; Johar et al., 2022), defining high-loss households as those reporting damages exceeding the sample median. We estimate the impact using a two-period balanced panel with individual and household fixed effects, which absorb all time-invariant individual- and household-level heterogeneity.

We examine three dimensions of mental health: depression, stress-related disability, and self-efficacy. Depression captures symptoms such as persistent sadness, hopelessness, and loss of interest in daily activities. Stress-related disability measures the extent to which psychological distress interferes with work, household responsibilities, and social interactions. Self-efficacy reflects individuals' perceived confidence in their ability to cope with future challenges, a forward-looking dimension of psychological well-being that is particularly relevant for recovery and adaptation in the aftermath of disaster (Bandura et al., 1999). As such, self-efficacy functions as a form of psychological capital, shaping individuals' willingness to invest in recovery, engage in labour markets, and adapt to future shocks, with direct implications for long-run economic resilience.

Our findings reveal gender-differentiated effects on self-efficacy. While individuals in high-loss households experience a 3.09% reduction in self-efficacy on average, this effect is driven entirely by female spouses. Female spouses in high-loss households experience a 5.65% decline in self-efficacy five to seven months after the cyclone relative to women in low-loss households, while male spouses show no significant change. Our identification exploits within-individual changes over time, with individual fixed effects absorbing all time-invariant individual and household differences. The intensity and spatial distribution of cyclone damage are plausibly exogenous to household characteristics (Belasen and Polachek, 2008), and the effect is robust to policy-relevant damage thresholds, alternative reporters, and an objective rainfall-based exposure measure, reducing concerns about reporting bias or selection into damage. The estimated effect of high cyclone losses on wives' self-efficacy is 1.18 points more negative than the corresponding effect on husbands on the 7 to 28 self-efficacy scale, equivalent to approximately 0.26 of the wives' baseline standard deviation. This gender differential is statistically significant and robust to alternative definitions of cyclone damage, including subjective and objective measures. This effect is also consistent across all seven components of the self-efficacy index. We find no corresponding effects on depression or stress-related disability for either gender. High cyclone losses do not affect these outcomes; rather, they erode women's forward-looking beliefs about their capacity to recover and adapt.

We investigate the economic mechanisms underlying this gender-specific decline. We first test whether deteriorating household-level economic conditions after the cyclone can account for the decline in women's self-efficacy. We find no support for this; high-loss households show no greater decline in consumption or income five to seven months after the shock. This redirects attention to gender differences in coping strategies as shaping how spouses recover psychologically after the shock (Dercon, 2002; Skoufias, 2003). While households may employ a range of coping strategies following shocks, including drawing on savings, selling assets, or borrowing, we focus on labour market responses, for which we have detailed spousal data. Relative to low-loss households, husbands in high-loss households are 14.5% more likely to engage in wage employment and report 26.8% higher wage earnings, while wives' participation in income-generating activities and income from any source remain unchanged. We interpret this increase in men's wage engagement as distress-driven coping rather than an improvement in labour market conditions as it occurs precisely among households reporting severe cyclone losses, and is concentrated in ganyu casual labour, the form of employment poor households turn to when other income sources fail. Husbands respond to severe losses by working more, while wives' participation remains unchanged, a pattern more consistent with constrained access to labour-market coping than with choice. This asymmetry offers one explanation for the divergence in self-efficacy. Taking an active economic role in recovery may sustain husbands' confidence in their ability to cope, while wives, excluded from this coping channel, experience the shock without a corresponding sense of agency.

To provide suggestive evidence on whether coping constraints rather than pre-existing low self-efficacy drive the observed gender gap, we analyse the relationship between specific cyclone-induced losses and subsequent spousal self-efficacy. These losses include damage to plots, livestock losses, business losses, and wage-related income losses directly attributable to Cyclone Idai. As with our headline damage measure, the incidence of these specific losses is driven by the physical footprint of the cyclone, including which plots flooded, which structures were destroyed, and whose employer's premises were damaged, and is therefore plausibly unrelated to pre-existing psychological traits. If low self-efficacy were driving labour market disengagement, we would not expect cyclone-induced wage losses to systematically predict subsequent changes in self-efficacy. However, we find that cyclone-related wage income loss is associated with an approximately 4% reduction in wives' self-efficacy, while no corresponding association is observed for husbands. Taken together, this additional analysis provides suggestive evidence that coping constraints represent an important channel linking high cyclone damages to declines in women's self-efficacy in our sample.

Heterogeneity by women's pre-cyclone economic agency highlights the role of intra-household bargaining power in shaping post-shock psychological adjustment. Both the self-efficacy effect and the labour-market asymmetry are concentrated among households where women had low productive agency before the cyclone. In these households, women experience an 8.15% decline in self-efficacy following high cyclone-related losses, and husbands become 25.25% more likely than their wives to enter wage employment. Neither effect appears among households where women had higher pre-shock agency. This further supports the proposed labour-market mechanism. When women enter the shock with limited economic agency, coping responses are concentrated among husbands while wives' economic roles remain unchanged, amplifying the gender gap in self-efficacy in high-loss households.

We also examine geographic heterogeneity by comparing districts with differing historical flood exposure. The decline in wives' self-efficacy relative to their husbands is more pronounced in Mangochi, where floods are less frequent, than in Nsanje, a district characterized by recurrent flooding. This pattern suggests that repeated disaster exposure may foster adaptive coping behaviour or psychological resilience that mitigates adverse mental health effects. Similar patterns emerge when comparing households reporting annual or biannual flooding to those reporting floods only once every five or ten years. These findings are consistent with prior research showing that past disaster exposure can influence preparedness and adaptive responses to future shocks (Kohn et al., 2012; Castañeda et al., 2020).

This paper makes three contributions to the empirical literature on climate vulnerability. First, we extend the literature by examining disaster-induced changes in forward-looking psychological resilience beyond conventional mental health indicators, such as depression and stress-related disability (Kessler et al., 2008; Heanoy and Brown, 2024; Makwana, 2019). In particular, we highlight the importance of self-efficacy as a measure of adaptive capacity, capturing individuals' perceived ability to recover and respond to future challenges following climate shocks. Second, this paper provides causal evidence on intra-household psychological responses to natural disasters, highlighting gender-differentiated mental health effects within households. While much of the existing literature characterises mental health outcomes using information from a single respondent within the household or treats the household as a single unit of analysis, this study adopts a spouse-level approach by separately examining the psychological responses of wives and husbands living together. Although previous research has documented gender differentiated effects of household shocks on various outcomes (Goh et al., 2012; Kumar and Quisumbing, 2014; Fruttero et al., 2024), our study is among the first to document a gender-differentiated intra-household response in mental well-being to a shared natural disaster.

Third, the paper documents a labour-market-based coping mechanism through which gendered economic responses may shape psychological resilience following climate shocks. The results suggest that asymmetric post-shock labour adjustments, where husbands increase wage employment while wives' economic participation remains largely unchanged, may contribute to the observed divergence in self-efficacy between spouses. While prior studies have identified income diversification as an important coping strategy (Dercon, 2002; Ellis, 2000; Dedehouanou and McPeak, 2020), we provide suggestive evidence that gender differences in labour market participation may influence the ability to mitigate the psychological consequences of disaster shocks. These results highlight that disaster impacts are mediated not only by exposure to shocks but also by differential access to economic adjustment channels.

The paper is structured as follows. Section 2 provides a conceptual framework to outline the channels through which natural disasters might affect mental well-being; Section 3 gives an overview on the country context, the cyclone, and on the data we use in this paper; Section 4 discusses identification and estimation; Section 5 presents the results and explores mechanisms; Section 6 concludes.

2 Conceptual Framework

Natural disasters impose both immediate and long-term consequences on economic and mental health outcomes, with these effects often reinforcing each other. Economically, disasters lead to sudden income losses, unemployment spikes, and disruptions in local markets (Dartanto, 2022; Norris et al., 2002). Emergency aid, often seen as a critical survival mechanism, can provide temporary relief to affected households in the immediate aftermath. While such assistance may help cushion short-term impacts, available aid does not necessarily facilitate a full recovery to pre-disaster economic conditions (Daly et al., 2020).

The mental health consequences of natural disasters, documented primarily in the public health literature, manifest both immediately and over time (Makwana, 2019; Heanoy and Brown, 2024; Bell et al., 2017; Maruyama et al., 2001; Frankenberg et al., 2008; Hrabok et al., 2020). In the immediate aftermath, individuals commonly experience acute stress reactions, heightened anxiety, and trauma due to displacement, loss of property, and disruptions to social and economic structures (Norris et al., 2002; Heanoy and Brown, 2024; Saeed and Gargano, 2022). Research estimates that nearly one-third of those affected by natural disasters experience some form of negative mental health impact (Heanoy and Brown, 2024). These psychological consequences can persist and, in some cases, intensify over time. Kessler et al. (2008) found that post-traumatic stress disorder (PTSD) and depression following disasters can worsen (and emerge) in

the medium term.

While the broader relationship between economic outcomes and mental health is well documented in the literature (Ridley et al., 2020), establishing the direction of causality in the peri-disaster setting remains challenging. In the aftermath of a disaster, individuals may experience significant disruptions in their financial stability, which can exacerbate pre-existing mental health issues or trigger new psychological distress, such as anxiety, depression, or PTSD. On the other hand, individuals facing mental health challenges may struggle to engage in recovery efforts, including securing employment, accessing financial aid, or participating in rebuilding their communities, which can further impede economic recovery. For instance, de Quidt and Haushofer (2016) find that the experience of shocks could create pessimistic beliefs regarding the returns to effort, potentially leading to a decrease in human and capital investment and labour supply. This reinforcing dynamic complicates efforts to determine whether economic hardship from disasters leads to poor mental health outcomes or whether mental health issues hinder post-disaster economic recovery.

2.1 *Role of Coping Mechanisms*

Households adopt a range of coping mechanisms in response to the economic shocks induced by natural disasters, with these strategies playing a crucial role in shaping their recovery (Skoufias, 2003; Heltberg et al., 2015; Dercon et al., 2005; Nguyen et al., 2020). One common strategy is labour supply adjustment, where individuals may increase their work hours, seek employment in alternative sectors, or migrate to areas with better job opportunities (Gröger and Zylberberg, 2016; Fernández et al., 2014; Martinoty, 2022). However, if wage opportunities decline due to disaster-induced destruction, limited labour market options can hinder recovery (Kirchberger, 2017).

Another key coping mechanism involves financial adjustments, such as drawing down savings, borrowing from formal or informal sources, or relying on remittances from family members abroad (Kazianga and Udry, 2006; Le De et al., 2013). While these financial flows can provide short-term relief, they may not fully compensate for long-term income losses and can increase household debt burdens. Additionally, households may choose to sell assets to generate immediate income, but this can deplete their long-term wealth and undermine future recovery (Hallegatte and Przulski, 2010).

Conversely, poor mental health can limit an individual's ability to engage in productive economic activities, hindering workforce participation and entrepreneurship, which in turn slows down recovery efforts (Lund et al., 2010; Hallegatte et al., 2020). In particular, a lack of self-efficacy in achieving a goal can hinder proactive engagement in coping mechanisms following

traumatic experiences (Benight and Bandura, 2004). Importantly, self-efficacy is not merely a downstream symptom of depression or stress, but rather a distinct psychological construct that mediates broader mental health outcomes (Muris, 2002). Bandura et al. (1999) demonstrate that self-efficacy operates as a pathway through which adverse experiences shape mental well-being, with low self-efficacy predicting depression rather than the reverse, underscoring its role as an independent and forward-looking dimension of psychological resilience. This relationship has long-term implications for economic prospects, as communities with persistent financial and mental health challenges may experience reduced productivity, lower human capital accumulation, and diminished economic growth over time (Loayza et al., 2012).

2.2 Gender Differential in Impacts and Resilience

While natural disasters affect all individuals within an exposed area, their impacts are not gender neutral. Erman et al. (2021), in a comprehensive review of the existing evidence on the gender dimensions of disaster risk and resilience, concluded that women are disproportionately affected by disasters across several dimensions, including life expectancy, unemployment, re-entry into the labour force, and relative asset losses. Norris et al. (2002), in a review of disaster mental health research, identify gender, poverty, limited prior coping experience, and eroded beliefs in one's ability to cope and control outcomes as key risk factors for poor mental health outcomes following disasters, with gender effects varying across cultural contexts. In many cases, these gender differences can be traced to inequalities caused by socioeconomic conditions, cultural beliefs, and traditional practices which put females at a disadvantage (Robles and Benavidez, 2020).

Engagement with post-disaster coping strategies also differs by gender (Ikeda, 1995; Quisumbing et al., 2011; Afridi et al., 2022). For instance, Afridi et al. (2022) find that women are less likely to work outside their village and migrate relative to men in response to droughts in India and consequently are not at the centre of a labour market solution to an adverse agricultural productivity shock. Ikeda (1995) finds that the options for women to cope with shocks, such as the 1991 cyclone in Bangladesh, were limited due to gender norms that affected their access to information and their decision-making power. In addition, post-natural disasters, especially during the reconstruction phase, women may face limited job opportunities due to the types of jobs available (Venn, 2012).¹

For women, structural inequalities such as economic marginalisation, caregiving burdens, and limited access to resources compound the challenges they face in disaster recovery (Enarson

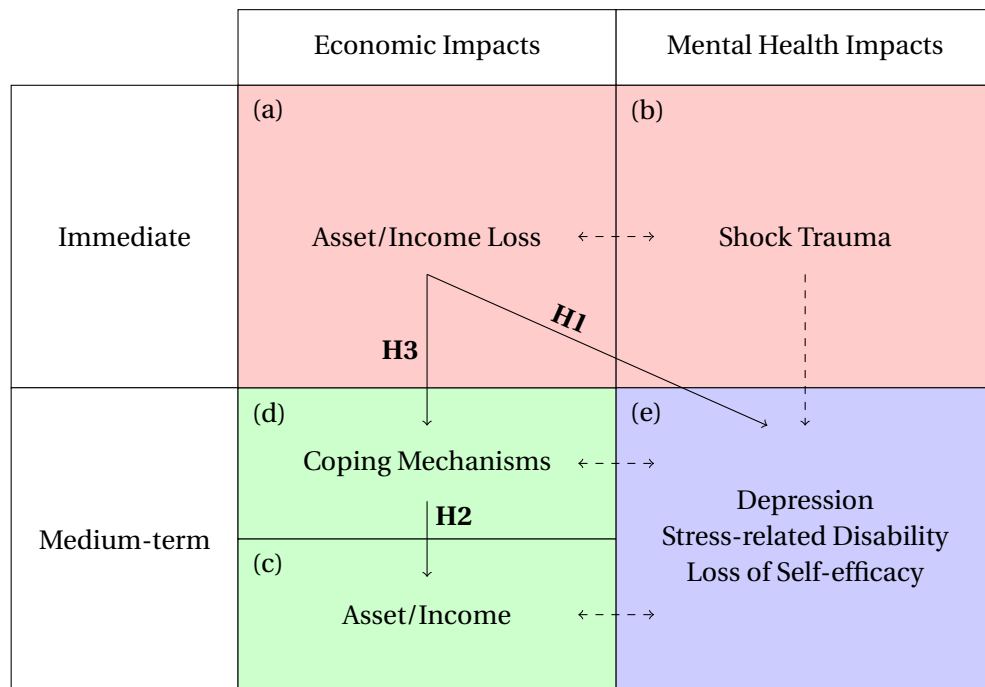
¹ Empirically, alternative scenarios may also exist. For example, Hoang and Van Thi Le (2021) find evidence that, in agrarian societies where men have an advantage in agricultural activities, natural disasters can disproportionately affect agricultural activities and therefore reduce men's power relative to women.

et al., 2000). Where women are unable to engage in effective coping strategies, constrained recovery opportunities may deepen psychological distress, with the psychological costs of disaster potentially both deeper and more persistent.

2.3 Theory of Change and Hypotheses

The direction of interlinkage between natural disasters, mental health and economic outcomes is theoretically ambiguous. Their differentiated impacts by gender add further complexity, making this an empirical question. Building on the discussion above, we propose a simple conceptual framework in Figure 1 that outlines how natural disasters affect households over time. The framework is organised into immediate impacts (top row) and medium-term outcomes (bottom row), with economic impacts on the left and mental well-being impacts on the right. In this paper, we define medium term as approximately 5-7 months post-cyclone.

Figure 1: Theory of Change



Note: Hypotheses H1–H3 correspond to the labelled pathways. H4 concerns gender differences in each pathway and is therefore not shown as a separate arrow.

When a disaster strikes, households experience immediate asset and income losses (quadrant a), alongside psychological shock and trauma (quadrant b). Over time, these immediate impacts shape medium-term outcomes through several pathways. First, the initial trauma can lead to persistent mental health challenges such as depression and loss of self-efficacy (quadrant e). Second, households adopt various coping mechanisms, such as adjusting labour supply or drawing on savings, to recover economically (quadrant d), which in turn influences their medium-term

asset and income levels (quadrant c). The dashed arrows indicate feedback loops: mental well-being and economic outcomes can reinforce each other, and engaging in coping mechanisms can both affect and be affected by mental health. Critically, in the 5-7 month timeframe examined in this study, we view coping mechanisms as the key channel through which the disaster continues to shape economic outcomes, as households' ability to activate and sustain recovery strategies becomes the primary determinant of their economic trajectory after a disaster.

Based on this conceptual framework, we propose the following hypotheses, which we will test in this paper by examining the impact of experiencing a high level of damage as a result of Cyclone Idai in Malawi:

- *Hypothesis 1:* Suffering large losses in a natural disaster negatively affects mental health in the medium term.
- *Hypothesis 2:* Suffering large losses in a natural disaster leads to lower income or asset ownership in the medium term.
- *Hypothesis 3:* Suffering large losses in a natural disaster leads to changes in household coping strategies in the medium term.
- *Hypothesis 4:* Suffering large losses in a natural disaster impacts the mental well-being, economic outcomes, and coping strategies of spouses differently.

3 Context and Data

3.1 Context

Malawi remains one of the poorest countries in the world, with a Human Development Index (HDI) value of 0.483 in 2019, ranking 174th out of 189 countries (UNDP, 2020). The country's economy is heavily dependent on agriculture, which supports approximately 80% of rural livelihoods, contributes around 30% to GDP, and accounts for 80% of export revenue (World Bank Group, 2021). This economic structure makes households particularly vulnerable to climate shocks, as extreme weather events directly threaten agricultural productivity, food security, and overall economic stability. The combination of extreme poverty, economic dependence on agriculture, and increasing climate-related disasters makes Malawian households particularly vulnerable, further exacerbating the socio-economic and psychological toll of natural disasters.

Malawi's geographical and climatic conditions further compound its vulnerability. Its location along the Great African Rift Valley, coupled with climate variability and environmental degradation, makes it highly susceptible to extreme weather events (Government of Malawi, 2019). Ac-

cording to the World Bank Group (2021), the country is particularly prone to floods, which have increased in frequency, intensity, and magnitude over the past two decades, leading to severe consequences for food and water security, water quality, energy resources, and sustainable livelihoods. Flooding is a recurring climatic challenge in Malawi, particularly affecting the central and southern regions, including the districts of Mangochi and Nsanje (Figure A.1). For instance, based on our calculations from the Emergency Events Database (EM-DAT), Nsanje has experienced 14 flood events between 2000 and 2019. Cyclones further exacerbate the risks of flooding in Malawi, intensifying the frequency and severity of extreme weather events. Tropical cyclones, particularly those forming in the southwest Indian Ocean, contribute to heavy rainfall and storm surges, increasing the likelihood of widespread flooding.

The event of interest for this study, Cyclone Idai, passed between southern Mangochi and northern Nsanje from March 6 to March 8, 2019. The cyclone was immediately preceded and followed by heavy rains and strong winds, triggering severe flooding that lasted from March 4 to March 10, 2019. According to the World Meteorological Organization (2019), Cyclone Idai was one of the most severe weather-related disasters ever recorded in the southern hemisphere. The cyclone and its associated floods had catastrophic consequences for Malawi. Government estimates indicate that over 975,600 people were affected, with 86,976 individuals displaced, 60 fatalities recorded, and 288,371 houses damaged or destroyed, leading to an estimated economic loss of USD 220 million (Government of Malawi, 2019).

3.2 Data

We exploit a two-year panel dataset comprising 1,331 couples across 100 villages in the cohort-2 pre-treatment sample from the districts of Mangochi and Nsanje, Malawi, covering 2018 and 2019 (see Figure A.2 for the specific timeline).² The couple roster is balanced across the two waves, while the estimation sample varies by outcome because of item non-response. The poorest households with both spouses present were selected into the sample through a community ranking exercise or proxy means test. The first wave was collected between July and October 2018, five to eight months before Cyclone Idai, while the second wave was conducted between August and October 2019, approximately five to seven months after the cyclone, allowing us to identify medium-term effects. In each survey round, a structured two-hour interview was administered separately to both the male and female spouses in each household. The survey collected household-level data on education, agriculture, employment, and income-generating ac-

² Our sample only includes couples interviewed in both waves. Temporary migration is captured if the spouse had returned by the second wave, but couples where a spouse migrated permanently, are not included in our sample. Our estimates therefore do not reflect the psychological effects of the cyclone operating through permanent migration.

tivities, alongside various other socioeconomic characteristics. In addition, the survey collected individual-level data on mental well-being, empowerment, and relationship quality. Importantly, all questions related to mental well-being were fielded before the module related to the effects of Cyclone Idai, minimising the risk that cyclone-related questions would prime respondents' mental health responses. These data were collected as part of a broader Randomised Control Trial (RCT) study, prior to the implementation of any experimental interventions.³

Table 1, which presents key descriptive statistics, shows us that on average households in our sample have five members, with an average age of the female and male spouse being 35 years and 42 years, respectively. Approximately 32% of wives report being literate, compared to 62.7% of husbands. On average, households have an annual household income of USD 411.91 PPP adjusted (2018, real) excluding total harvest value, which is an important source of income as many households are subsistence farmers. On average, households reported an annual expenditure of USD 1,335.64 PPP adjusted (2018, real), which translates into an average annual consumption of USD 267 PPP adjusted (2018, real) per household member.⁴ Households report an average food security score of 3.99 on a scale from 0 to 9, suggesting below-median food security scores. Our sample is almost evenly split between the districts of Mangochi and Nsanje.

We construct our measure of cyclone exposure using detailed household-level damage reports collected from female spouses. A large majority of households in the sample, 88.3%, reported being affected by Cyclone Idai, with considerable variation in the severity of losses. To capture this variation while maintaining a tractable treatment definition, we construct a binary indicator equal to one for households reporting damage above the sample median of 37,000 Malawian Kwacha, and zero otherwise. In our sample, 50.3% of households fall into this high-loss category. Figure H.1 shows the distribution of reported damage. The absence of any spike around the median threshold suggests that self-reporting is unlikely to be systematically biased by households anticipating incentives tied to damage thresholds. Since damage is reported by the female spouse, whose psychological outcomes are central to our analysis, a natural concern is that more distressed respondents over-report losses, generating a mechanical link between reported damage and mental health. We test the robustness of our results to damage measures reported by husbands and by village heads, and to a rainfall-based exposure measure that is independent of any household report.

We use household-level damage as our primary treatment variable as it provides the most di-

³ The RCT evaluates a Graduation program, with a gender empowerment training, in Malawi. See AEARCTR-0007605 for further details. Both survey waves used in this paper predate the assignment and rollout of any intervention arms for cohort 2.

⁴ The gap between income and expenditure is driven mainly by own-produced consumption. Since most households are subsistence farmers, we impute a value for crops grown and consumed at home. This is included in expenditure but not counted as income.

rect and granular measure of cyclone-related losses at the household level, capturing variation in material damage that village-level exposure measures cannot. While cyclones are partially anticipated events, the precise timing, intensity, and spatial distribution of damage from extreme winds and flooding are plausibly exogenous to household characteristics (Belasen and Polachek, 2008). This supports the use of total reported damage as a credible proxy for the severity of cyclone-related losses, allowing us to compare mental health and economic outcomes between high- and low-loss households.

Our dataset includes individual-level mental well-being indicators across three distinct psychological domains. Depression is measured using a nine-item scale assessing the number of days in the previous week on which the respondent did not experience depressive symptoms. Stress-related disability is measured using a four-item scale evaluating the respondent's ability to perform daily activities over the past week. Finally, self-efficacy is assessed using a seven-item index measuring an individual's optimistic self-belief regarding their ability to cope with various life challenges. In all three indices, higher scores correspond to better mental health outcomes.⁵ Higher self-efficacy scores reflect stronger perceived resilience and confidence in managing adversity. A detailed breakdown of the mental health indices and their components is provided in Appendix C.

Before Cyclone Idai in 2018, female spouses in the sample had an average score of 41.72 out of 63 on the depression index, 21.37 out of 28 on the disability-stress-related index, and 21.24 out of 28 on the self-efficacy index. For our male sample, on average, men had a 45.88 out of 63 for the depression index, 22.49 out of 28 on the disability-stress related index, and 21.42 out of 28 on the self-efficacy index.

Table B.1 documents the different experiences of Cyclone Idai in Mangochi and Nsanje. The proportion of households affected and the level of damage are higher in Nsanje than in Mangochi. These differences reflect the two districts' geographies. Nsanje is located between the Shire River to the East and the Nsanje mountains to the West. The Shire river regularly floods its banks during rainy periods, and cyclones also cause damaging rainwater run-off from the mountains, harming crops and household assets. Mangochi is at a higher altitude to the East of Lake Malawi, so it does not suffer from regular river flooding. During Cyclone Idai, though, heavy rains caused local flooding, and both regions also experienced wind damage. As a result, 86% of Nsanje households in our sample experience flooding annually or bi-annually compared with 13% in Mangochi. Still, over 77% of households in Mangochi were affected by Cyclone Idai, suggesting

⁵ Following Bossuroy et al. (2022), self-efficacy is measured using a 6-item version of the initial 20-item General Self-efficacy (GSE) scale specifically in relation to problem solving, goal pursuit, and coping, and a related self-esteem question (Rosenberg, 1965). Later in the analysis, we analyse the results for each individual component as a robustness check to ensure that our findings are not driven by any single item in the composite index.

Table 1: Descriptive Statistics

	Mean	SD	Count
Household Characteristics			
Household Size	5.472	1.933	1331
Wife Age	35.154	12.203	1331
Husband Age	42.281	13.919	1331
Wife Literacy (0/1)	0.318	0.466	1331
Husband Literacy (0/1)	0.627	0.484	1331
District (0=Nsanje, 1=Mangochi)	0.491	0.500	1331
Household Income (MWK)	107197.397	170435.735	1331
Household Expenditure (MWK)	347593.422	257035.953	1331
Food Consumption (MWK)	247223.675	207156.899	1331
Non-food Consumption (MWK)	69475.316	84996.394	1321
Food Security (0=Insecure, 9=Secure)	3.986	2.193	1331
Flood Statistics			
Flooding Frequency (1=Annual, 5=No Memory)	2.986	1.779	1331
Affected by March 2019 Flood (0/1)	0.883	0.322	1314
Value of March 2019 Flood Damage (MWK)	59697.805	77332.517	1331
Mental Health			
Wife Depression	41.719	10.504	1331
Husband Depression	45.878	9.403	1331
Wife Stress-related Disability	21.369	5.747	1331
Husband Stress-related Disability	22.490	4.786	1331
Wife Self-efficacy	21.243	4.622	1331
Husband Self-efficacy	21.415	4.189	1331

Notes: All values are as of 2018, except for the flood statistics where the responses necessarily pertain to 2019. All household characteristics and flood statistics assume the husbands' responses on behalf of the household, except age, literacy, and mental health variables which are the personal responses of the respective spouse. Monetary values are in MWK (Malawian Kwacha); at the 2018 average market exchange rate of approximately 732 MWK/USD, mean household income corresponds to roughly USD 146 and mean flood damage to roughly USD 82 (nominal; PPP-adjusted figures reported in the text differ). The depression scale is the inversed sum of answers to nine questions asking the days in the last week the respondent felt a particular depression symptom, thus ranging from 0 to 63. The stress-related disability scale is the inversed sum of answers to four questions asking the days in the last week the respondent felt a particular stress-related disability symptom, thus ranging from 0 to 28. The self-efficacy scale is the inverse sum of Likert scale responses to seven questions relating to self-efficacy starting from 1 (strongly agree) to 4 (strongly disagree), thus ranging from 7 to 28. Hence, all variables are coded such that higher scores on the depression, stress-related disability and self-efficacy scales correspond to lower levels of depression and stress, and higher levels of self efficacy, respectively (i.e. they are all increasing in mental health).

widespread exposure to the cyclone regardless of location, with the regularity of exposure being the main differentiating factor between the two regions. As we use a panel fixed effects model, our estimation strategy addresses time-invariant geographic and structural differences between districts, including baseline flood risk.

4 Empirical Specification

To investigate how a high level of cyclone-induced damage influences mental well-being, we use a panel fixed-effects regression, as outlined in Equation (1).

$$y_{iht} = \alpha_i + \beta Shock_{ht} + \gamma_t + \delta X_{iht} + \epsilon_{iht} \quad (1)$$

where y_{iht} is our outcome of interest for individual i in household h at time t . Our primary outcomes of interest are the measures of mental health: depression, stress-related disability and self-efficacy. $Shock_{ht}$ is a dummy variable indicating whether the cyclone damage incurred by household h in the post-cyclone period, as reported by the female spouse, is above the median damage (37,000 MWK). γ_t denotes time fixed effects and α_i denotes individual fixed effects, which absorb all time-invariant heterogeneity at the individual level, including unobserved household, village, and district characteristics that may influence mental health outcomes. X_{iht} is a vector of time-varying controls including respondent age and age squared, household size, and an indicator for post-cyclone relief receipt. Relief reached a minority of households and was only weakly targeted: 29% of households in Mangochi and just 11% in Nsanje received any relief, reflecting access constraints from destroyed roads and bridges, and receipt correlates only modestly with reported damage ($\rho = 0.21$; see Appendix H).

Standard errors are clustered at the village level to account for correlated unobservables among households within the same village, which share geographical and social characteristics that may determine both cyclone exposure and mental health outcomes. To examine intra-household gender differences, we estimate equation (1) separately for wives and husbands. We apply the same specification to labour market outcomes to investigate gender-differentiated coping responses, including participation in income-generating activities and income earned from those activities.

Our identification strategy rests on the assumption that, conditional on individual fixed effects and time-varying controls, the extent of cyclone damage is effectively random, uncorrelated with unobserved time-varying determinants of mental health and labour market outcomes. One potential concern is that even low-loss households in heavily affected villages may be indirectly

affected through disrupted local labour markets or changes in goods prices. If such spillovers exist, they would narrow the gap between high- and low-loss households, leading us to understate the true effect, thus implying that our results represent a lower bound on the true effect of cyclone damage.

Our primary treatment variable relies on household reports of cyclone-related damage, an approach with a long tradition in the literature on shocks and household welfare in developing countries (Dercon et al., 2005; Heltberg et al., 2015; Arouri et al., 2015), and one that has been used to identify the effects of disaster damage on human capital and health outcomes in both developing and developed country settings (Deuchert and Felfe, 2015; Johar et al., 2022). Self-reported damage offers a key advantage over area-level exposure measures: it captures household-specific variation in material losses that satellite- or rainfall-based measures, assigned at coarser spatial resolutions, necessarily miss. Indeed, recent work comparing survey-based and remotely sensed flood measures finds that only household-reported measures detect losses among directly affected households, with severely affected and unaffected households coexisting within the same exposed communities (Bangalore et al., 2026). At the same time, self-reports raise two well-documented concerns: strategic or perception-based misreporting correlated with respondent characteristics (Nguyen and Nguyen, 2020), and, in our setting, the fact that damage is reported by the female spouse whose psychological outcomes we study.

We address these concerns in several ways. As a first check on strategic reporting, we show that reported damage exhibits no bunching around the government relief thresholds of 15,000 and 35,000 MWK, which is inconsistent with over-reporting tied to anticipated assistance (Figure H.1). Beyond this, we employ five alternative definitions of severe cyclone shock at the household level. First, we redefine high-loss households using a threshold of 35,000 MWK, corresponding to the government's disaster relief amount, allowing us to assess sensitivity relative to this policy-relevant benchmark. Second, we redefine high-loss households using a threshold of 15,000 MWK, equivalent to the government's social cash transfer. Our results are also robust to replacing the binary indicator with a continuous damage measure (Appendix I). Third, we incorporate village-level reports of cyclone damage collected from village heads or representatives, classifying households as affected if their village reported significant cyclone damage, which allows us to compare self-reported damage with village-level assessments. Fourth, we examine flooding damage to agricultural plots as reported by husbands, as a proxy for cyclone-induced productivity shocks. Flooding damage to plots may not correspond perfectly to cyclone damage, but flooding was one of the primary consequences of the cyclone, so this measure tests whether our results hold when damage is reported by the husband rather than the wife. Both the third and fourth measures rely

on reporters whose assessments are independent of the wife's psychological state.

Fifth, we construct an objective measure of cyclone exposure based on rainfall data rather than self-reported damage. We obtain daily rainfall data from TAMSAT at a spatial resolution of 0.0375 (approximately 4km) and match our 100 villages to their nearest grid points using GPS coordinates, yielding 29 unique rainfall values, as some villages fall within the same or neighbouring grid cells. We compare cumulative rainfall during March 2019, when Cyclone Idai struck, to the long-term average for the same month over 1994-2017. Cumulative rainfall in March 2019 ranged from 216mm to 343mm across villages, compared to a long-term average of 79mm to 200mm. We classify a household as experiencing a rainfall shock if its village's March 2019 rainfall exceeded the long-term mean by at least 1 standard deviation.⁶

Beyond measurement robustness, we also examine whether the impact of the cyclone varies across households of certain characteristics. The impact of the cyclone on spouses may be heterogeneous due to a number of reasons, including (i) spatial, as the annual exposure to shocks may vary which can impact how households recover from shocks, as those that experience more regular shocks may learn from prior experiences, while those who do not face regular natural disasters may not have had this learning to draw from (Kohn et al., 2012; Castañeda et al., 2020); (ii) baseline level of women's empowerment which impacts her self-efficacy and ability to engage in shock-coping mechanisms (Kabeer, 1999; Doss, 2013); (iii) baseline relationship quality which could affect how individuals in the household communicate and make shock-coping decisions to recover from the shock (Baland and Ziparo, 2018). To test this, we run four additional regressions, analysing our mental well-being results by district, frequency of flooding, baseline level of women's productive agency, and baseline level of women's relationship quality. As a final robustness check, we adjust our main specification for multiple hypothesis testing.

5 Results

5.1 Effect of High Cyclone Damage on Mental Health

Our analysis indicates that natural disasters can undermine not just physical assets but also psychological resources critical for recovery. We find that individuals in high-loss households experience a reduction in self-efficacy by 3.09% (Table 2). This reduction in self-efficacy is reflected consistently across all individual components of the index, with each component showing a statistically significant decline (Table D.3).

⁶ We use a 1 SD threshold rather than the conventional 2 SD cutoff (Pazos et al., 2024) because a 2 SD threshold would eliminate any within-district variation in our setting, classifying all households in Nsanje as experiencing the shock despite substantial heterogeneity in self-reported damage (Figure G.1). The 1 SD threshold preserves some variation while still identifying abnormal rainfall events.

In contrast, we detect no significant effects on depression or stress-related disability. The absence of effects on depression and stress-related disability is itself informative. It suggests that the medium-term psychological impact of the cyclone operates specifically through forward-looking beliefs about recovery capacity rather than through current depression or stress-related disability.⁷

The literature conceptualises self-efficacy as a protective psychological resource that buffers the effects of daily stressors and supports adaptive coping (Bandura, 1977; Benight and Bandura, 2004). A decline in self-efficacy, therefore, suggests a weakening of individuals' perceived ability to manage adversity, even in the absence of increases in depressive symptoms or functional impairment. By eroding this forward-looking sense of agency, the cyclone may increase vulnerability to future climate shocks. The absence of effects on depression or stress-related disability, combined with the decline in self-efficacy, provides partial support for *Hypothesis 1*. This suggests that climate-related disasters can have important effects on forward-looking attitudes and perceptions of agency, dimensions that prove critical for long-term recovery trajectories.

Utilising intra-household spousal data, we also examine gender-differentiated effects of high cyclone damage (Table 2). We find that wives' self-efficacy in high-loss households decreases by 5.65% compared to low-loss households, while we do not observe statistically significant changes in any of the husbands' mental health outcomes, including self-efficacy.⁸ Moreover, the gender gap in how high cyclone losses affect self-efficacy is statistically significant. Wives' estimated effect is 1.18 points more negative than husbands' on the self-efficacy scale, equivalent to about 0.26 of the wives' baseline standard deviation. In contrast, we find no significant effects of cyclone damage on depression or stress-related disability for either gender. These findings are in line with the literature on intra-household disparities in the effects of shocks, which has primarily documented unequal impacts on outcomes such as consumption, nutrition, and labour outcomes (Hoddinott, 2013; Mottaleb et al., 2015). Our results show that gender disparities also emerge in psychological resilience. Even when overall measures of mental distress remain unchanged, women experience a relative decline in forward-looking beliefs about their capacity to cope and recover compared to their spouses.

A decline in self-efficacy in high-loss households, as outlined in our conceptual framework, could result from the direct psychological effects of experiencing a disaster or the economic disruptions that exacerbate stress and anxiety. To test the existence of economic disruptions in high-loss households, we analyse the effects of high cyclone-induced losses on key household

⁷ Most individual components of these two measures also show no significant effect for either spouse (Tables D.1, D.2).

⁸ This decrease in self-efficacy is consistent across all individual components for wives (Table D.3)

Table 2: Effect of Cyclone Shock on Mental Health

	Depression		Stress-related Disability		Self-efficacy	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A - Full Sample						
Cyclone Shock	0.045	-0.113	0.314	0.247	-0.664***	-0.685***
	(0.421)	(0.418)	(0.269)	(0.285)	(0.228)	(0.234)
Panel B - By Gender						
Wife	0.307	0.142	0.505	0.414	-1.215***	-1.265***
	(0.638)	(0.636)	(0.431)	(0.446)	(0.340)	(0.349)
N	2606	2606	2606	2606	2606	2606
Husband	-0.271	-0.418	0.077	0.039	-0.093	-0.088
	(0.678)	(0.683)	(0.346)	(0.358)	(0.298)	(0.303)
N	2594	2594	2594	2594	2596	2596
Wife - Husband	0.58	0.56	0.43	0.38	-1.12	-1.18
Wife - Husband (p-value)	0.40	0.41	0.22	0.30	0.00	0.00
Control Mean - All	43.97	43.97	22.12	22.12	22.15	22.15
Control Mean - Wife	42.37	42.37	21.56	21.56	22.40	22.40
Control Mean - Husband	45.57	45.57	22.67	22.67	21.90	21.90
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are individually-reported depression, stress-related disability, and self-efficacy. The depression and stress-related disability variables are reverse-coded so that higher values indicate lower levels of depression and stress-related disability (i.e., for all variables, higher scores correspond to better mental health outcomes). Panel A indicates the effect of the cyclone shock on the entire sample's mental health variables. Panel B rows *Wife* and *Husband*, indicate the effect of the cyclone shock on females' and males' mental health variables, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represent the effect on females' mental health relative to males' and the corresponding p-value, respectively. Control means of each mental health variable for the entire sample as well as the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief controlled for are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

economic indicators, income, expenditure, and food security (Table 3). We find no significant effects on these outcomes in the medium run, regardless of whether we control for receipt of relief assistance. Similarly, we find no impact on total household asset value or on productive asset categories, including agriculture and business asset values (Table E.1). These results do not support *Hypothesis 2*, and we therefore rule out household economic losses as a direct mechanism driving the self-efficacy decline. One possible explanation for the absence of medium-term economic effects is that households were able to smooth consumption and protect assets through coping mechanisms. To test this, we focus specifically on labour market adjustments as a potential channel through which high cyclone-related losses may influence self-efficacy.

Diversifying income sources by adjusting labour supply is a well-documented coping strategy in response to economic shocks in low- and middle-income countries (Dercon, 2002; Skoufias, 2003). Our data capture labour-related losses in the cyclone module alongside individual-level

Table 3: Effect of Cyclone Shock on Household Economic Wellbeing

	Income		Expenditure		Food security	
	(1)	(2)	(3)	(4)	(5)	(6)
Cyclone Shock	40.341 (37.395)	33.849 (36.603)	0.065 (0.046)	0.049 (0.047)	-0.100 (0.154)	-0.093 (0.156)
N	2628	2628	2628	2628	2606	2606
Control Mean - Household	348.79	348.79	1.04	1.04	3.85	3.85
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are husband-reported household income, expenditure, and food security. The table indicates the effect of the Cyclone Shock on household economic variables. Monetary values are converted from Malawian Kwacha to US dollar (real 2018) for ease of interpretation and to account for inflation. Expenditure is expenditure per adult per day. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Control means of each household economic variable are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief controlled for are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

labour market participation for both spouses, allowing us to examine differential coping within the household. We analyse the impact of high cyclone-related losses on husbands' and wives' labour force participation to assess whether gender-differentiated coping strategies help explain the observed psychological effects of high cyclone damage.

Our analysis (Table 4) shows that husbands in high-loss households, relative to those in low-loss households, are 14.5% more likely to engage in wage employment, while wives' engagement in income-generating activities remains unchanged.⁹ This gender disparity in the labour market response is statistically significant at the 5% level. A similar trend is observed in wage earnings, where husbands' income from wage employment increases by approximately 26.8%, though this is only significant at the 10% level. We find no significant changes in wives' income from any source (Table 6). These findings provide support for *Hypotheses 3 and 4*, which predict that households adjust through labour-based coping strategies in the medium term and that these adjustments differ across spouses. The increase in husbands' wage engagement and earnings may help explain why we do not observe significant declines in overall household economic outcomes, consistent with the absence of support for *Hypothesis 2*.

The lack of engagement in coping mechanisms, such as labour force participation, could be an explanation for the observed decline in wives' self-efficacy relative to their husbands. Engaging in income-generating activities during crises may provide individuals with a sense of control and resilience, reinforcing their belief in their ability to shape future outcomes (Gibbs, 1989; Freedy

⁹ In this context, wage employment refers primarily to ganyu casual labour, the dominant form of wage work among poor rural households in our sample.

Table 4: Effect of Cyclone Shock on Labour (Extensive Margins)

	Livestock (0/1)		Harvest (0/1)		Business (0/1)		Wage (0/1)	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wife	0.067** (0.033)	0.047 (0.032)	-0.017 (0.017)	-0.018 (0.018)	0.026 (0.032)	0.011 (0.031)	0.008 (0.031)	0.010 (0.031)
N	2628	2628	2628	2628	2628	2628	2628	2628
Husband	0.043 (0.033)	0.045 (0.033)	-0.008 (0.018)	-0.012 (0.018)	0.016 (0.026)	0.013 (0.026)	0.089** (0.034)	0.087** (0.035)
N	2628	2628	2628	2628	2628	2628	2628	2628
Wife - Husband	0.02	0.00	-0.01	-0.01	0.01	-0.00	-0.08	-0.08
Wife - Husband (p-value)	0.46	0.95	0.64	0.74	0.67	0.96	0.02	0.03
Control Mean - Wife	0.29	0.29	0.96	0.96	0.32	0.32	0.15	0.15
Control Mean - Husband	0.27	0.27	0.95	0.95	0.23	0.23	0.60	0.60
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are livestock, harvest, business, and wage labour at the extensive margin. Livestock and harvest labour are reported by the male on their own and their wife's behalf, while business and wage labour are reported individually. The rows *Wife* and *Husband* indicate the effect of the cyclone shock on females' and males' labour activities, respectively (1 indicating yes). The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represent the effect on females' labour activities relative to males' and the corresponding p-value, respectively. Control means of each labour activity for the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief controlled for are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

et al., 1992). Conversely, the absence of such opportunities may result in diminished agency, consistent with lower self-efficacy and a greater sense of hopelessness. In regard to *Hypothesis 4*, the results support the hypothesis for at least one dimension of women's mental well-being in our sample, the very dimension that enables individuals to face future challenges. Two features of the setting suggest that wives' unchanged participation reflects constraint rather than choice. First, wage employment in this context consists overwhelmingly of *ganyu* casual labour, for which demand rises during post-disaster reconstruction but which is socially typed as male work, particularly for tasks such as rebuilding and clearing (Venn, 2012). Second, the concentration of both the self-efficacy decline and the labour asymmetry among households where women had low pre-shock productive agency (Section 5.2) is difficult to reconcile with a preference-based explanation: if wives' non-participation reflected choice, we would not expect the psychological cost to be borne precisely by the women with the least control over household resources.

However, a potential challenge to our argument is reverse causality. Low self-efficacy may prevent women from engaging in coping mechanisms such as labour force participation, rather than the lack of engagement in coping causing declines in self-efficacy. To provide suggestive evidence of the relationship between shock-induced economic constraints and women's self-efficacy, we

analyse the correlation between specific cyclone-induced losses and spousal self-efficacy in 2019. In particular, we examine household reports of wage income loss, plot damage, business damage and livestock loss attributable to the cyclone, and assess how these losses correlate with individual self-efficacy outcomes. Because these losses are directly linked to cyclone exposure, they are plausibly exogenous to pre-existing psychological traits. If low self-efficacy were driving labour market disengagement, we would not expect cyclone-induced wage losses to predict subsequent changes in self-efficacy. However, as shown in Table 7, wage income loss among high-loss households is associated with an approximately 4% reduction in wives' self-efficacy, while husbands' self-efficacy remains unaffected. This analysis provides suggestive evidence that coping mechanisms represent an important channel linking high cyclone damage to changes in self-efficacy. This does not, however, rule out other channels through which wage income loss could affect self-efficacy independently of coping behaviour, for instance, shifts in the spousal balance of resource control.

Table 5: Effect of Cyclone Shock on Labour (Intensive Margins)

	Livestock days		Harvest days	
	(1)	(2)	(3)	(4)
Wife	2.112*	1.293	0.404	-0.004
	(1.185)	(1.171)	(0.732)	(0.777)
N	2628	2628	2552	2552
Husband	1.697*	1.732*	0.499	0.008
	(0.931)	(0.923)	(0.726)	(0.798)
N	2628	2628	2628	2628
Wife - Husband	0.42	-0.44	-0.09	-0.01
Wife - Husband (p-value)	0.66	0.64	0.90	0.99
Control Mean - Wife	8.24	8.24	14.59	14.59
Control Mean - Husband	6.08	6.08	14.77	14.77
Individual FE	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes

Notes: The dependent variables are livestock and harvest labour at the intensive margin. Livestock and harvest labour are reported by the male on their own and their wife's behalf. The rows *Wife* and *Husband* indicate the effect of the cyclone shock on females' and males' labour activity, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represents the effect on females' labour activities relative to males' and the corresponding p-value, respectively. Control means of each labour activity for the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table 6: Effect of Cyclone Shock on Income

	Livestock		Harvest		Business		Wage	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Wife	3.211 (2.814)	2.065 (2.777)	-3.218 (3.303)	-4.253 (3.570)	1.809 (18.143)	-1.512 (17.849)	21.755 (16.905)	26.810 (17.996)
N	2628	2628	2628	2628	2564	2564	2628	2628
Husband	-2.446 (3.487)	-1.433 (3.193)	-4.408 (4.229)	-3.664 (4.049)	-6.293 (23.397)	-7.848 (20.988)	41.975* (24.236)	43.634* (25.843)
N	2628	2628	2628	2628	2320	2320	2628	2628
Wife - Husband	5.66	3.50	1.19	-0.59	8.10	6.34	-20.22	-16.82
Wife - Husband (p-value)	0.11	0.28	0.78	0.88	0.73	0.76	0.41	0.52
Control Mean - Wife	4.78	4.78	5.57	5.57	59.31	59.31	121.28	121.28
Control Mean - Husband	6.34	6.34	9.95	9.95	103.42	103.42	162.81	162.81
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are livestock, harvest, business, and wage income. Livestock and harvest income are reported by the male on their own and their wife's behalf, while business and wage income are reported individually. The rows *Wife* and *Husband* indicate the effect of the cyclone shock on female and male income sources, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represents the effect on females' income relative to males' and the corresponding p-value, respectively. Control means of each income for the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

5.2 Heterogeneous effects of high cyclone damage

We examine whether the intra-household gender gap in the impact of high cyclone related damages on self-efficacy varies across spatial and intra-household characteristics. First, we analyse the differential effects across the two districts in our sample. As illustrated in Figure A.1, floods occur more frequently in Nsanje than in Mangochi. To further explore *Hypothesis 1*, we examine whether frequent exposure to disasters influences the extent to which high cyclone damages affect individuals' self-efficacy. Our findings from Table 8 (Panel A) support this hypothesis. The decline in wives' self-efficacy relative to their husbands, following exposure to high cyclone losses, is primarily driven by households in Mangochi. In contrast, in Nsanje, where flood-related shocks occur frequently, individuals may have developed adaptive coping mechanisms that mitigate the psychological impact of such events.

To further validate this explanation, we compare the effects of cyclone shocks on self-efficacy among households in our sample that report experiencing floods annually or biannually versus those that report experiencing floods once every five or ten years (Table 8, Panel B). The results are consistent with our district-level comparison. The gender differential in self-efficacy reduction following high level of cyclone damage is primarily driven by households that do not experience

Table 7: Channels of Cyclone Shock - Correlation Between Household-level Damage and Individual Self-efficacy

	SE - All		SE - Wife		SE - Husband	
	(1)	(2)	(3)	(4)	(5)	(6)
Livestock Damage (0/1)	-0.234 (0.259)	-0.200 (0.259)	-0.305 (0.309)	-0.319 (0.313)	-0.235 (0.329)	-0.157 (0.330)
N	2601	2601	1303	1303	1298	1298
Plot Damage (0/1)	-1.059*** (0.186)	-1.053*** (0.186)	-1.603*** (0.261)	-1.668*** (0.265)	-0.462* (0.252)	-0.389 (0.257)
N	2601	2601	1303	1303	1298	1298
Business Damage (0/1)	0.128 (0.351)	0.154 (0.350)	-0.114 (0.450)	-0.121 (0.447)	0.363 (0.394)	0.418 (0.400)
N	2601	2601	1303	1303	1298	1298
Wage Income Loss (0/1)	-0.422** (0.192)	-0.397** (0.195)	-0.914*** (0.281)	-0.939*** (0.281)	0.160 (0.223)	0.234 (0.227)
N	2635	2635	1320	1320	1315	1315
Control Means	22.99	22.99	23.57	23.57	22.40	22.40
Relief	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are individually-reported self-efficacy in 2019. The columns *SE - All*, *SE - Wife*, and *SE - Husband* indicate the correlation between household damages and self-efficacy in 2019. The number of observations are those that contribute to the corresponding estimation (individuals in 2019). Control means of self-efficacy for the entire sample, as well as female and male subsamples are presented. Estimations with and without relief are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

floods regularly.

We next examine whether labour market coping behaviour varies across districts. Table F.1 (Panel A) presents gender-differentiated engagement in income-generating activities across districts for high-loss households relative to low-loss households. The results show that, regardless of location, men are more likely than their wives to adjust labour market participation in response to high cyclone damage. For instance, in Mangochi, the area with a lower frequency of natural shocks, men are more likely to be able to engage in agriculture and business activities than their wives, while in Nsanje, an area with higher flood frequency, husbands are more likely to engage in wage labour in response to shocks than their wives. This suggests that labour force participation is a key coping strategy regardless of region, though the region and past flood exposure may determine which type of labour coping strategy is used. Overall, the results are consistent with *Hypothesis 4*, which predicts that coping responses to large losses differ between spouses.

Next, we explore whether the intra-household gender differential in self-efficacy from high cyclone-related losses varies based on wives' baseline bargaining power. We use a measure of productive agency that captures women's access to and control over resources as a proxy for bargaining power. Women with below-median productive agency prior to the shock experience an 8.1% decline in self-efficacy following high cyclone losses, whereas no significant decline is ob-

served among women with higher baseline agency.

Consistent with the labour mechanism, gender differences in post-shock wage labour participation are concentrated in low-agency households (Table F.1, Panel C). In these households, husbands are 25.25% more likely to engage in wage employment than their wives, while no significant gender differential in wage employment is observed in high-agency households. These findings reinforce the interpretation that limited access to labour market coping opportunities contributes to the gender gap in psychological resilience among households facing severe cyclone damage.

Finally, we investigate whether intra-household relationship dynamics, particularly relationship quality between spouses, influence the decline in wives' self-efficacy in high-loss households. The decline in women's self-efficacy is observed across both low and high relationship quality households (Table F.1, Panel D), suggesting that the psychological burden of the shock operates independently of reported marital relationship quality.

5.3 Robustness checks

We assess the robustness of our findings on the impact of above median losses from the cyclone on intra-household mental health outcomes by employing alternative definitions of the cyclone shock. Given the potential biases associated with self-reported cyclone-related damages, we explore different thresholds of damage and consider alternative respondents and measures to verify the reliability of our results (Table 9).

We first test sensitivity to the damage threshold itself. Using a threshold of 35,000 MWK, wives in affected households exhibit a 5.6% reduction in self-efficacy, and our intra-household results hold. Lowering the threshold to 15,000 MWK, wives in affected households exhibit a 6.9% reduction in self-efficacy, showing that even relatively minor financial losses are associated with the effects we document. Results are also robust to using a continuous measure of cyclone damage in place of the binary indicator (see Table I.1 in Appendix I).

We next test whether these effects hold when damage is reported by someone other than the wife. Using village-level reports of cyclone damage in place of wives' self-reports, we find a comparable reduction in wives' self-efficacy (5.24%) to our main specification. Using husbands' reports of flood-related damage in place of wives' reports, we find a similar reduction (5.15%), closely aligning with our main results. Across both alternative thresholds and alternative sources of reporting, the gender gap in self-efficacy impacts remains consistent.

As our next robustness check, we use an objective measure of cyclone exposure based on rainfall data, and unlike our main specification, this rainfall-based measure yields statistically significant effects across all three dimensions of mental well-being (Table 9). Consistent with our main

findings, women in rainfall-affected households experience a significant decline in self-efficacy, with a larger magnitude than in our main specification. However, they also report significantly lower levels of depression and stress-related disability, effects that are absent in our main results. We interpret this as reflecting differences in what the two measures capture rather than a contradiction of our main findings. Self-reported damage identifies households that experienced severe and salient cyclone-specific losses, those most likely to trigger the responses we document. Rainfall, by contrast, is assigned at the level of the nearest weather grid point, which spans multiple villages and cannot capture variation in material losses driven by topography, drainage, or housing quality. Households in a high-rainfall grid cell but with low self-reported damage may have experienced disruption without catastrophic loss, potentially explaining the broader effects on depression and stress-related disability that this measure picks up but our main specification does not. The robust self-efficacy effect nonetheless supports the broader pattern that cyclone exposure carries adverse psychological consequences for women, with self-efficacy as the most durable and precisely estimated dimension of impact.

We interpret the positive coefficients on depression and stress related disability under the rainfall specification cautiously. Rainfall exposure is assigned at the grid-cell level and captures a broader, on average milder, measure of cyclone exposure than household-reported material damage. The component-level results in Tables D.4 and D.5 suggest that some dimensions of acute distress may have begun to resolve by five to seven months after the cyclone, although these patterns are not sufficiently consistent to support a firm interpretation. What is robust across exposure measures, by contrast, is the decline in wives' self-efficacy and the absence of a corresponding effect for husbands. We therefore view the rainfall specification primarily as supporting the robustness of the gender-differentiated self-efficacy result, rather than as providing clear evidence on depression or stress-related disability.

As our final robustness check we correct for multiple-hypothesis testing for our main specification (D.6), and our results hold.

Table 8: Heterogeneous Effect of Cyclone Shock on Mental Health

	Depression	Wife Stress-related Disability	Self-efficacy	Depression	Husband Stress-related Disability	Self-efficacy
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A - By District						
Nsanje	0.837 (0.829)	0.554 (0.475)	0.085 (0.403)	-0.057 (0.881)	0.427 (0.620)	0.176 (0.447)
N	1340	1340	1340	1334	1334	1334
Mangochi	-0.764 (0.922)	-0.296 (0.715)	-1.179** (0.499)	-0.937 (1.085)	-0.388 (0.500)	-0.119 (0.457)
N	1266	1266	1266	1260	1260	1262
Wife - Husband (Nsanje, p)	0.32	0.84	0.84			
Wife - Husband (Mangochi, p)	0.87	0.86	0.02			
Control Mean - Nsanje	42.39	21.42	21.99	45.62	22.51	21.82
Control Mean - Mangochi	42.35	21.71	22.83	45.52	22.84	21.99
Panel B - By Typical Flood Frequency						
Low Frequency	-1.012 (0.881)	-0.207 (0.665)	-1.532*** (0.468)	-0.986 (1.085)	-0.213 (0.481)	-0.069 (0.453)
N	1290	1290	1290	1284	1284	1286
High Frequency	1.149 (0.844)	0.686 (0.494)	-0.170 (0.438)	0.048 (0.896)	0.067 (0.594)	0.263 (0.443)
N	1316	1316	1316	1310	1310	1310
Wife - Husband (Low Frequency, p)	0.98	0.99	0.00			
Wife - Husband (High Frequency, p)	0.22	0.30	0.33			
Control Mean - Low Frequency	42.77	21.74	22.80	45.44	22.85	22.03
Control Mean - High Frequency	41.97	21.39	22.00	45.70	22.49	21.78
Panel C - By Wife's Productive Agency						
Low Agency	-0.124 (0.997)	-0.163 (0.519)	-1.789*** (0.464)	-0.556 (0.865)	0.204 (0.464)	-0.162 (0.427)
N	1308	1308	1308	1302	1302	1304
High Agency	0.505 (1.011)	0.943 (0.700)	-0.668 (0.452)	-0.137 (1.016)	-0.032 (0.484)	-0.146 (0.410)
N	1298	1298	1298	1292	1292	1292
Wife - Husband (Low Agency, p)	0.62	0.43	0.00			
Wife - Husband (High Agency, p)	0.53	0.05	0.20			
Control Mean - Low Agency	42.21	21.72	21.94	44.88	22.31	21.80
Control Mean - High Agency	42.54	21.40	22.87	46.27	23.04	22.01
Panel D - By Couple's Relationship Quality						
Low Relationship Quality	0.668 (0.873)	0.581 (0.704)	-1.123** (0.513)	-0.620 (1.090)	-0.118 (0.531)	-0.340 (0.432)
N	1300	1300	1300	1290	1290	1292
High Relationship Quality	-0.204 (0.825)	0.369 (0.566)	-1.328*** (0.412)	-0.198 (0.966)	0.195 (0.424)	0.173 (0.458)
N	1306	1306	1306	1304	1304	1304
Wife - Husband (Low Quality, p)	0.24	0.19	0.07			
Wife - Husband (High Quality, p)	0.99	0.68	0.00			
Control Mean - Low Quality	41.32	21.06	22.12	44.87	22.53	21.81
Control Mean - High Quality	43.42	22.07	22.68	46.27	22.81	22.00

Notes: The dependent variables are individually-reported depression, stress-related disability, and self-efficacy. The columns *Wife* and *Husband* indicate the heterogeneous effect of the cyclone shock on female and male mental health variables, respectively, along several dimensions. Panel A, rows *Nsanje* and *Mangochi*, indicates the effect of the cyclone shock on respondents' mental health of those residing in Nsanje and Mangochi, respectively. Panel B, rows *Low Frequency* and *High Frequency*, indicates the effect of the cyclone shock on respondents' mental health of those reporting flooding once every 5 or more years and either annually or biannually, respectively. Panel C, rows *Low Agency* and *High Agency*, indicates the effect of the cyclone shock on respondents' mental health of those living in households where the wife reports below average and above average agency, respectively. Panel D, rows *Low Relationship Quality* and *High Relationship Quality*, indicates the effect of the cyclone shock on respondents' mental health of those living in households where the wife reports below average and above average relationship quality, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Row *Wife - Husband (dimension, p)* represents the p-value of the effect on female's mental health relative to male's along the respective heterogeneous dimension. Control means of each mental wellbeing scale for the female and male subsamples by the respective heterogeneous dimension are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Only estimations including relief as a control are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 9: Robustness Checks: Effect of Various Damage Variables on Individual Mental Health

	Depression	Wife Stress-related Disability	Self-efficacy	Depression	Husband Stress-related Disability	Self-efficacy
	(1)	(2)	(3)	(4)	(5)	(6)
Damage $\geq$ MWK15000 (0/1)	-0.283 (0.791)	0.433 (0.522)	-1.654*** (0.334)	-1.200 (0.797)	0.130 (0.406)	0.192 (0.330)
N	2606	2606	2606	2594	2594	2596
Wife - Husband (p-value)	0.25	0.46	0.00			
Damage $\geq$ MWK35000 (0/1)	0.010 (0.647)	0.263 (0.447)	-1.341*** (0.365)	-0.553 (0.687)	-0.102 (0.335)	-0.194 (0.296)
N	2606	2606	2606	2594	2594	2596
Wife - Husband (p-value)	0.41	0.28	0.00			
Village Affected by Floods (0/1)	0.029 (0.785)	0.064 (0.492)	-1.163** (0.522)	0.819 (0.845)	1.073** (0.438)	-0.279 (0.419)
N	2604	2604	2604	2592	2592	2594
Wife - Husband (p-value)	0.35	0.02	0.04			
Bad Harvest due to Flood	-0.371 (0.628)	0.079 (0.355)	-1.513*** (0.278)	1.320** (0.646)	0.439 (0.318)	-0.078 (0.301)
N	2630	2630	2630	2628	2628	2630
Wife - Husband (p-value)	0.01	0.26	0.00			
Rainfall Shock (1sd) (0/1)	1.355* (0.764)	1.489*** (0.425)	-2.679*** (0.489)	0.760 (0.864)	-0.078 (0.449)	-0.567 (0.399)
N	2640	2640	2640	2628	2628	2630
Wife - Husband (p-value)	0.49	0.00	0.00			
Rainfall Shock (2sd) (0/1)	1.129 (0.782)	1.724*** (0.456)	-3.346*** (0.397)	0.315 (0.801)	0.098 (0.442)	-0.621 (0.414)
N	2640	2640	2640	2628	2628	2630
Wife - Husband (p-value)	0.31	0.00	0.00			
Control Mean	42.37	21.56	22.40	45.57	22.67	21.90
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Relief	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are individually-reported depression, stress-related disability, and self-efficacy. The panels indicate the effect of the cyclone shock (as measured by the various alternative indicators) on the corresponding females' and males' mental health variables, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Row *Wife - Husband (p-value)* represents the p-value of the effect on female's mental health variable relative to male's. Control means of each mental health variable for the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Only estimations including relief as a control are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

6 Conclusion

This paper examines the psychological consequences of natural disaster damages within households, with a focus on gender-differentiated effects on mental health and economic coping behaviour. Using alternative damage thresholds, different shock reporters, we consistently find that affected wives experience a 3-7% decline in self-efficacy while husbands' remains unchanged, creating a statistically significant gender gap post-shock. Depression and stress-related disability remain unchanged, suggesting that the psychological impact operates specifically through forward-looking beliefs about recovery capacity rather than symptoms of depression or stress.

We find no evidence that this divergence is driven by deteriorating household-level economic conditions. Instead, the results are suggestive of a gender-differentiated labour market engagement as the key mechanism. Following high cyclone-related losses, husbands significantly increase their participation in wage employment and report higher wage earnings, while wives' engagement in income-generating activities remains unchanged. Cyclone-induced wage-income losses are associated with subsequent declines in women's self-efficacy but not in men's, consistent with constrained economic coping as one explanation for the gender gap. Heterogeneity analysis reinforces this interpretation. The self-efficacy gap and the asymmetric labour market response are both concentrated in households where women had low productive agency prior to the cyclone and are absent in households where women entered the shock with greater economic agency. Together, these findings are consistent with a mechanism in which the lack of engagement in labour market recovery may undermine women's confidence in their capacity to rebuild.

The paper highlights that the psychological costs of disasters are not distributed uniformly within households. Even when aggregate economic outcomes, consumption and income are unaffected, the distribution of coping opportunities within the household is associated with divergent psychological outcomes across spouses. These findings are consistent with post-shock coping opportunities being gender differentiated, with paid labour market opportunities playing a central role in determining who recovers and who does not following a climate shock. Standard analyses that treat the household as a single unit of analysis or focus on a single respondent will miss these dynamics.

The results also underscore the importance of self-efficacy as a dimension of disaster impact that is distinct from conventional mental health indicators such as depression and stress-related disability. High cyclone losses do not increase clinical symptoms of distress in our sample, but they do erode women's forward-looking beliefs about their ability to recover, a dimension of psychological well-being that is directly relevant to long-run adaptation. Finally, the findings point to pre-existing economic agency as an important moderator of disaster resilience. Where women

have limited access to labour markets prior to a shock, their psychological recovery is more vulnerable when that shock arrives.

Our sample was selected through a proxy-means test and community ranking into the poorest couple-headed households in 100 villages across two flood-prone districts of southern Malawi. This is a population of direct policy interest, the target of most social protection and disaster-response programmes, but three boundaries on generalisability follow. Our estimates speak to intact couples, not to single, widowed, or separated women, nor to households dissolved or displaced by the cyclone, for whom coping constraints are likely more binding. Drawn from the bottom of the wealth distribution, the sample may have thinner psychological and economic buffers than the wider population. And wives' low baseline wage participation (15%) reflects local gender norms; where women's labour market attachment is stronger, the asymmetric coping channel we document may be attenuated.

These results carry direct implications for disaster response and social protection policy. Programmes that expand women's access to wage employment, credit, and skill development in disaster-prone regions could simultaneously strengthen economic and psychological resilience, addressing the labour market constraints that appear to drive self-efficacy losses. Broader interventions that strengthen women's productive agency before shocks occur, rather than only responding after, may be particularly effective, given that pre-shock agency is a key moderator of post-shock outcomes in our setting. Mental health support should be integrated into disaster recovery programmes, particularly for women facing systemic barriers to economic participation, given that constrained coping opportunities and eroded psychological resilience may reinforce each other. Finally, addressing the gender norms that restrict women's labour market engagement may be as important as expanding formal employment opportunities, since access alone may be insufficient where social constraints on women's economic participation remain binding. As climate change increases both the frequency and severity of natural disasters, understanding how their psychological costs are distributed within households and what determines who recovers will only become more important.

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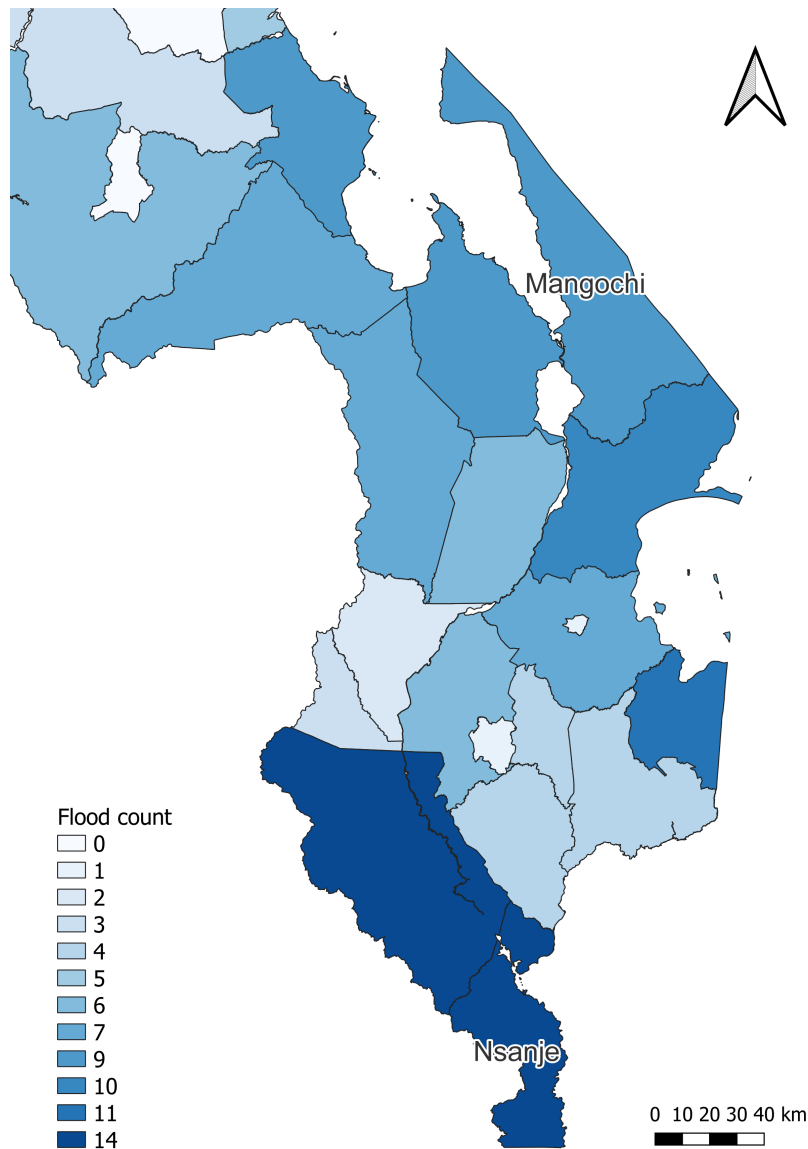
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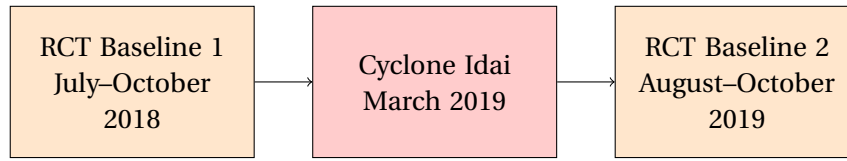
Appendix A Flood Exposure and Data Timeline

Figure A.1: Floods during 2000-2019



The figure is produced using QGIS; floods with at least one of the following criteria fulfilled: 10 or more people dead; 100 or more people affected/injured/homeless; declaration by the country of a state of emergency and/or an appeal for international assistance, from the Centre for Research on the Epidemiology of Disasters' (CRED) Emergency Events Database (EM-DAT).

Figure A.2: Panel Dataset Timeline



Appendix B Cyclone Damage by Districts

Table B.1: Summary Statistics by District

	N	(1) Mangochi	N	(2) Nsanje	(2)-(1)
Affected by March 2019 Flood (0/1)	639	0.775	675	0.985	0.211***
Value of March 2019 Flood Damage (MWK)	654	44575.411	677	74306.440	29731.029***
Destruction $\geq$ 15k (0/1)	654	0.573	677	0.869	0.295***
Destruction $\geq$ 35k (0/1)	654	0.381	677	0.650	0.269***
Destruction $\geq$ 37k (0/1)	654	0.369	677	0.632	0.264***
Bad Harvest due to Floods (0/1)	654	0.313	677	0.708	0.394***
Village Affected by Cyclone Idai (0/1)	654	0.352	677	0.858	0.507***
High Relationship Quality (0/1)	654	0.440	677	0.557	0.117***
High Productive Agency (0/1)	654	0.497	677	0.501	0.004
High Flooding Frequency (0/1)	654	0.128	677	0.855	0.727***

Notes: All flood statistics necessarily pertain to 2019, while relationship quality, productive agency, and flood frequency statistics are as of 2018. All flood-related statistics assume the husbands' responses on behalf of the household (except the village measure which is reported by the village head), while relationship quality and productive agency assume the wives' responses. Monetary values are in MWK which stands for Malawian Kwacha, the currency of Malawi. Standard errors are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix C Mental health variable components

We have three mental well-being indices of depression, disability-stress related, and self-efficacy.

Depression (Table C.1) is measured using a 9-item version (due to data limitations) of the 10-item Center for the Epidemiological Studies of Depression (CES-D) scale designed to measure depressive symptoms in the general population (Radloff, 1977). This scale has demonstrated its ability to detect depression (Weissman et al. (1977) and Björgevinnsson et al. (2013)) and its application can be found in the economic literature (Singhal, 2019).

Disability (Table C.2) is measured using a 4-item version of the 20-item Self-Reporting Questionnaire (SRQ) developed by WHO to screen for psychiatric disturbance, especially in developing countries (Beusenberg et al., 1994).

Self-efficacy (Table C.3) is measured using a 6-item version of the initial 20-item General Self-efficacy (GSE) scale created to assess a general sense of perceived self-efficacy with the aim in mind to predict coping with daily hassles, as well as adaptation after experiencing all kinds of stressful events (Schwarzer and Jerusalem, 1995). The GSE scale has demonstrated strong psychometric properties and reliable measurement across diverse populations and cultural contexts (Scholz et al., 2002). Following (Bossuroy et al., 2022), one item from the 10-item Rosenberg Self-Esteem Scale (RSE) with the purpose to measure self-esteem (Rosenberg, 1965) is added to the GSE scale rendering it a 7-item scale. Benight and Bandura (2004) integrate findings from diverse studies on the role of self-efficacy in recovery from many different traumatic experiences, including natural disasters and find that self-efficacy is a focal mediator of post-traumatic recovery. Rippon et al. (2024) study the extent to which self-efficacy mediates the association between social support and mental health and find that it fully mediates the positive association. As such, self-efficacy is a medium which facilitates mental health.

Table C.1: Depression

Code	Question	Good/Bad
emo39	No. of days felt the details of life bothered you more than usual	Bad
emo40	No. of days felt you had trouble concentrating on what you were doing	Bad
emo41	No. of days felt sad	Bad
emo43	No. of days felt you were confident in the future	Good
emo44	No. of days felt nervous, tense, or worried	Bad
emo45	No. of days felt you had trouble sleeping peacefully	Bad
emo46	No. of days felt happy	Good
emo47	No. of days felt alone	Bad
emo48	No. of days felt so tired that you could do nothing	Bad

Note: Scale from 0 to 7. Inversed the “bads” so that all variables are increasing in mental wellbeing.

Table C.2: Stress-related Disability

Code	Question	Good/Bad
emo50	No. of days you have had a headache	Bad
emo51	No. of days your digestion was bad	Bad
emo52	No. of days you had difficulty fulfilling your family responsibilities	Bad
emo53	No. of days you had difficulties in your daily work	Bad

Note: Scale from 0 to 7. Inversed the “bads” so that all variables are increasing in mental wellbeing.

Table C.3: Self-efficacy

Code	Question	Good/Bad
emo13	You can always succeed in fixing problems if you put in enough effort	Good
emo14	It is easy for you to follow the path you would like and to accomplish your goals in life	Good
emo15	You are confident that you are able to handle unexpected events well	Good
emo16	You are able to remain calm when confronted with difficulties because you are able to adapt easily	Good
emo17	When you are faced with a problem to fix, you are often able to find multiple solutions	Good
emo18	When you find yourself in a difficult situation, you are often able to find a solution	Good
emo21	Rosenberg self-esteem: You are able to do things as well as most people	Good

Note: Scale from 1 (strongly agree) to 4 (strongly disagree). Inversed so that all variables are increasing in mental health.

Appendix D Heterogeneous Effect of Cyclone Shock on Labour

Table D.1: Effect of Cyclone Shock on Depression Components

	emo39_good (1)	emo40_good (2)	emo41_good (3)	emo43 (4)	emo44_good (5)	emo45_good (6)	emo46 (7)	emo47_good (8)	emo48_good (9)
Panel A - Full Sample									
Cyclone Shock	-0.104 (0.104)	0.012 (0.087)	0.054 (0.097)	-0.012 (0.152)	0.121 (0.094)	-0.214* (0.113)	-0.050 (0.135)	0.015 (0.084)	0.036 (0.097)
Panel B - By Gender									
Wife	-0.073 (0.161)	0.154 (0.128)	0.164 (0.146)	-0.105 (0.174)	0.088 (0.140)	-0.110 (0.171)	-0.077 (0.189)	0.010 (0.128)	0.059 (0.154)
N	2604	2600	2606	2588	2596	2606	2604	2604	2598
Husband	-0.144 (0.124)	-0.135 (0.133)	-0.064 (0.144)	0.083 (0.223)	0.150 (0.138)	-0.321* (0.166)	-0.024 (0.176)	0.005 (0.110)	0.002 (0.143)
N	2594	2590	2592	2594	2594	2594	2592	2592	2594
Wife - Husband	0.07	0.29	0.23	-0.19	-0.06	0.21	-0.05	0.01	0.06
Wife - Husband (p-value)	0.57	0.03	0.12	0.40	0.66	0.21	0.76	0.96	0.69
Control Mean - All	4.89	5.35	5.06	3.41	5.57	5.20	3.66	5.86	5.01
Control Mean - Wife	4.82	5.23	4.81	3.16	5.27	4.96	3.72	5.56	4.88
Control Mean - Husband	4.96	5.46	5.31	3.67	5.87	5.44	3.59	6.16	5.14
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are individually-reported depression components. Panel A indicates the effect of the cyclone shock on the entire sample's depression components. Panel B, rows *Wife* and *Husband*, indicates the effect of the cyclone shock on the females' and males' depression components, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represents the effect on females' mental depression components relative to males' and the corresponding p-value, respectively. Control means of each depression component for the entire sample as well as the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Only estimations including relief as a control are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table D.2: Effect of Cyclone Shock on Stress-related Disability Components

	emo50_good	emo51_good	emo52_good	emo53_good
	(1)	(2)	(3)	(4)
Panel A - Full Sample				
Cyclone Shock	0.123 (0.104)	-0.071 (0.063)	0.030 (0.110)	0.169 (0.116)
Panel B - By Gender				
Wife	0.149 (0.164)	-0.104 (0.094)	-0.002 (0.172)	0.378** (0.179)
N	2604	2606	2606	2606
Husband	0.088 (0.121)	-0.046 (0.080)	0.048 (0.169)	-0.052 (0.152)
N	2594	2594	2592	2592
Wife - Husband	0.06	-0.06	-0.05	-0.43
Wife - Husband (p-value)	0.61	0.47	0.77	0.01
Control Mean - All	5.21	6.56	5.12	5.23
Control Mean - Wife	4.64	6.46	5.24	5.23
Control Mean - Husband	5.79	6.66	4.99	5.23
Individual FE	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Relief	Yes	Yes	Yes	Yes

Notes: The dependent variables are individually-reported stress-related disability components. Panel A indicates the effect of the cyclone shock on the entire sample's stress-related disability components. Panel B, rows *Wife* and *Husband*, indicates the effect of the cyclone shock on the females' and males' stress-related disability components, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represents the effect on females' stress-related disability components relative to males' and the corresponding p-value, respectively. Control means of each stress-related disability component for the entire sample as well as the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Only estimations including relief as a control are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table D.3: Effect of Cyclone Shock on Self-efficacy Components

	emo13	emo14	emo15	emo16	emo17	emo18	emo21
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Panel A - Full Sample							
Cyclone Shock	-0.051 (0.037)	-0.115** (0.047)	-0.103* (0.056)	-0.149*** (0.053)	-0.061 (0.049)	-0.144*** (0.051)	-0.062 (0.051)
Panel B - By Gender							
Wife	-0.162*** (0.061)	-0.167** (0.074)	-0.182** (0.085)	-0.233*** (0.076)	-0.133* (0.073)	-0.234*** (0.074)	-0.154** (0.073)
N	2606	2606	2606	2606	2606	2606	2606
Husband	0.061 (0.050)	-0.060 (0.063)	-0.023 (0.081)	-0.060 (0.071)	0.015 (0.062)	-0.052 (0.075)	0.032 (0.071)
N	2596	2596	2596	2596	2596	2596	2596
Wife - Husband	-0.22	-0.11	-0.16	-0.17	-0.15	-0.18	-0.19
Wife - Husband (p-value)	0.00	0.09	0.05	0.02	0.02	0.02	0.01
Control Mean - All	3.49	3.29	2.83	3.18	3.13	3.01	3.23
Control Mean - Wife	3.45	3.34	2.97	3.19	3.16	3.04	3.26
Control Mean - Husband	3.53	3.23	2.69	3.17	3.11	2.98	3.19
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The dependent variables are individually-reported self-efficacy components. Panel A indicates the effect of the cyclone shock on the entire sample's self-efficacy components. Panel B, rows *Wife* and *Husband*, indicates the effect of the cyclone shock on the females' and males' self-efficacy components, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represents the effect on females' self-efficacy components relative to males' and the corresponding p-value, respectively. Control means of each self-efficacy component for the entire sample as well as the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Only estimations including relief as a control are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table D.4: Effect of Rainfall Shock on Less Depressed Components

	emo39_good	emo40_good	emo41_good	emo43	emo44_good	emo45_good	emo46	emo47_good	emo48_good
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Panel A - Full Sample									
Rain Shock	-0.150	0.225**	0.321***	0.112	0.027	0.106	-0.261*	0.096	0.250**
	(0.128)	(0.101)	(0.106)	(0.169)	(0.101)	(0.126)	(0.149)	(0.108)	(0.117)
Panel B - By Gender									
Wife	-0.108	0.378**	0.513***	-0.552**	0.366**	0.375*	-0.460**	0.147	0.436***
	(0.193)	(0.161)	(0.159)	(0.214)	(0.153)	(0.190)	(0.209)	(0.159)	(0.165)
<i>N</i>	2650	2648	2651	2642	2646	2651	2650	2650	2647
Husband	-0.199	0.068	0.121	0.769***	-0.313**	-0.167	-0.067	0.037	0.055
	(0.161)	(0.147)	(0.140)	(0.253)	(0.145)	(0.161)	(0.192)	(0.131)	(0.161)
<i>N</i>	2645	2643	2644	2645	2645	2645	2644	2644	2645
Wife - Husband	0.09	0.31	0.39	-1.32	0.68	0.54	-0.39	0.11	0.38
Wife - Husband (p-value)	0.57	0.04	0.01	0.00	0.00	0.00	0.04	0.40	0.02
Control Mean - All	4.89	5.35	5.06	3.41	5.57	5.20	3.66	5.86	5.01
Control Mean - Wife	4.82	5.23	4.81	3.16	5.27	4.96	3.72	5.56	4.88
Control Mean - Husband	4.96	5.46	5.31	3.67	5.87	5.44	3.59	6.16	5.14
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Notes: Standard errors clustered at the village level in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table D.5: Effect of Rainfall Shock on Less Disability[†] Components

	emo50_good (1)	emo51_good (2)	emo52_good (3)	emo53_good (4)
Panel A - Full Sample				
Rainfall Shock (0/1)	0.090 (0.096)	0.135** (0.062)	0.293** (0.133)	0.399*** (0.140)
Panel B - By Gender				
Wife	0.302* (0.158)	0.240** (0.095)	0.440** (0.188)	0.734*** (0.185)
<i>N</i>	2650	2651	2651	2651
Husband	-0.126 (0.114)	0.025 (0.084)	0.139 (0.195)	0.058 (0.189)
<i>N</i>	2645	2645	2644	2644
Wife - Husband	0.43	0.21	0.30	-0.68
Wife - Husband (p-value)	0.00	0.01	0.13	0.00
Control Mean - All	5.21	6.56	5.12	5.23
Control Mean - Wife	4.64	6.46	5.24	5.23
Control Mean - Husband	5.79	6.66	4.99	5.23
Individual FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Relief	Yes	Yes	Yes	Yes

[†] Stress-related illnesses/inability to complete responsibilities. *Notes:* Standard errors clustered at the village level in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table D.6: Multiple Hypothesis Testing: Sharpened q-values for Table 2 (Effect of Cyclone Shock on Mental Health, Relief-Controlled Specification)

Outcome	Sample	Coefficient	N	p-value	Sharpened q-value
Depression	Full Sample	-0.113	5200	0.788	1.000
Depression	Wife	0.142	2606	0.824	1.000
Depression	Husband	-0.418	2594	0.542	1.000
Stress-related Disability	Full Sample	0.247	5200	0.389	0.636
Stress-related Disability	Wife	0.414	2606	0.356	0.552
Stress-related Disability	Husband	0.039	2594	0.914	1.000
Self-efficacy	Full Sample	-0.685***	5202	0.004	0.014**
Self-efficacy	Wife	-1.265***	2606	0.000	0.002***
Self-efficacy	Husband	-0.088	2596	0.773	1.000

Notes: This table reports sharpened q-values adjusting for multiple hypothesis testing in Table 2, relief-controlled specification only (Benjamini et al., 2006). The three mental health outcomes (depression, stress-related disability, and self-efficacy) are treated as one family of hypotheses within each sample (Full/Wife/Husband); families are not pooled across samples. Stars in the Coefficient column denote significance based on the raw (unadjusted) p-value; stars in the Sharpened q-value column denote significance based on the multiple-testing-adjusted q-value. * p<0.10, ** p<0.05, *** p<0.01.

Appendix E Impact of High-loss Damages on Assets

Table E.1: Effect of Cyclone Shock on Household Asset

	Total Assets		Agriculture		Business		Household	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cyclone Shock	-67.018 (86.184)	-61.186 (82.373)	-64.375 (71.800)	-56.662 (66.789)	-0.869 (9.178)	-1.070 (9.476)	-8.007 (35.232)	-11.180 (34.144)
N	2628	2628	2628	2628	2628	2628	2604	2604
Control Mean - Household	1205.01	1205.01	154.26	154.26	36.78	36.78	446.25	446.25
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are households' total, agriculture, business, and household assets. The columns indicate the effect of the Cyclone Shock on assets owned by the household as reported by the male respondent. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Table E.2: Effect of Cyclone Shock on Total Assets by Ownership

	Total Assets		Assets-Wife		Assets-Husband		Assets-Joint	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Cyclone Shock	-67.018 (86.184)	-61.186 (82.373)	-6.353 (19.323)	-5.504 (18.735)	-16.262 (20.844)	-15.091 (21.462)	36.234 (36.833)	26.702 (36.075)
N	2628	2628	2238	2238	2600	2600	2560	2560
Control Mean - Household	1205.01	1205.01	157.12	157.12	231.41	231.41	277.30	277.30
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Household FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Relief	No	Yes	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are household assets by ownership. The columns indicate the effect of the Cyclone Shock on assets owned by the household, each spouse, and jointly. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief are presented. Standard errors clustered at the village level are in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Appendix F Heterogeneous Effect of Cyclone Shock on Labour

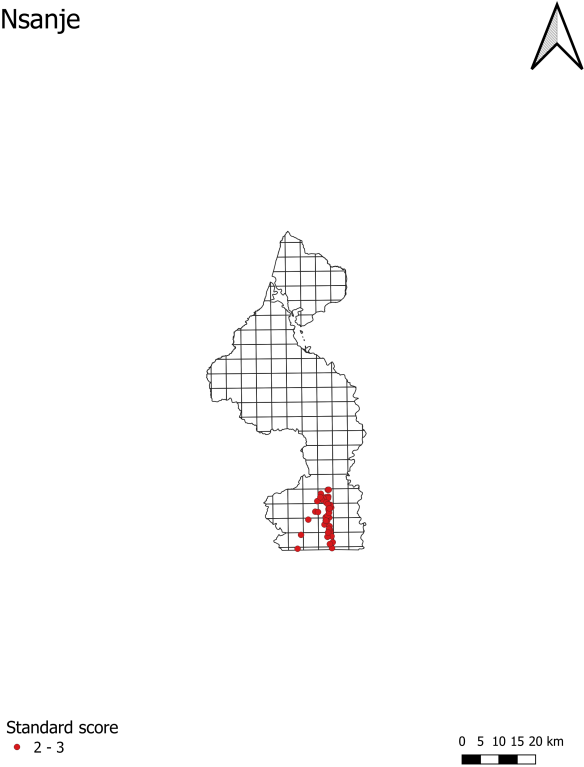
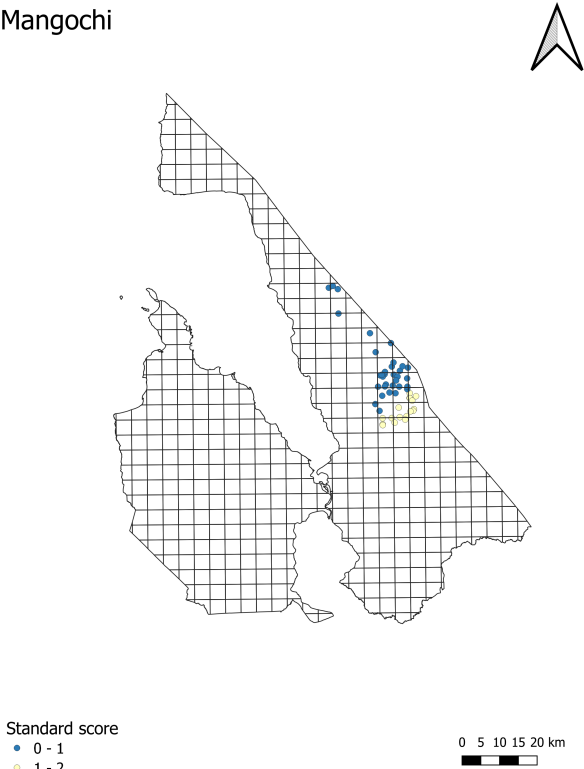
Table F.1: Heterogeneous Effect of Cyclone Shock on Labour (Extensive Margins)

	Wife				Husband			
	Livestock (1)	Harvest (2)	Business (3)	Wage (4)	Livestock (5)	Harvest (6)	Business (7)	Wage (8)
Panel A - By District								
Nsanje	0.065 (0.047)	-0.060* (0.030)	0.049 (0.046)	-0.001 (0.054)	0.066 (0.047)	-0.073** (0.030)	-0.005 (0.041)	0.093* (0.050)
N	1350	1350	1350	1350	1350	1350	1350	1350
Mangochi	0.020 (0.042)	-0.003 (0.019)	-0.083** (0.041)	-0.001 (0.038)	0.006 (0.041)	0.034* (0.020)	0.022 (0.040)	0.024 (0.048)
N	1278	1278	1278	1278	1278	1278	1278	1278
Wife - Husband (Nsanje, p)	0.99	0.67	0.20	0.07				
Wife - Husband (Mangochi, p)	0.72	0.07	0.03	0.59				
Control Mean - Nsanje	0.26	0.94	0.39	0.21	0.22	0.95	0.30	0.63
Control Mean - Mangochi	0.33	0.97	0.25	0.09	0.32	0.96	0.16	0.57
Panel B - By Typical Flood Frequency								
Low Frequency	0.075* (0.044)	0.013 (0.022)	0.013 (0.045)	-0.017 (0.037)	0.057 (0.039)	0.040* (0.023)	0.000 (0.040)	0.058 (0.046)
N	1302	1302	1302	1302	1302	1302	1302	1302
High Frequency	0.011 (0.049)	-0.062** (0.029)	0.004 (0.045)	0.038 (0.053)	0.018 (0.047)	-0.066** (0.030)	0.021 (0.037)	0.084* (0.050)
N	1326	1326	1326	1326	1326	1326	1326	1326
Wife - Husband (Low Frequency, p)	0.64	0.24	0.76	0.10				
Wife - Husband (High Frequency, p)	0.88	0.91	0.12	0.36				
Control Mean - Low Frequency	0.32	0.97	0.29	0.10	0.30	0.95	0.19	0.58
Control Mean - High Frequency	0.27	0.95	0.35	0.20	0.24	0.95	0.27	0.62
Panel C - By Wife's Productive Agency								
Low Agency	0.033 (0.042)	-0.023 (0.022)	0.044 (0.036)	0.046 (0.041)	0.059 (0.040)	-0.028 (0.026)	0.013 (0.037)	0.149*** (0.050)
N	1320	1320	1320	1320	1320	1320	1320	1320
High Agency	0.059 (0.051)	-0.013 (0.024)	0.018 (0.045)	-0.031 (0.044)	0.027 (0.051)	0.003 (0.022)	-0.002 (0.045)	0.012 (0.048)
N	1308	1308	1308	1308	1308	1308	1308	1308
Wife - Husband (Low Agency, p)	0.52	0.86	0.40	0.04				
Wife - Husband (High Agency, p)	0.54	0.48	0.89	0.37				
Control Mean - Low Agency	0.22	0.95	0.14	0.17	0.21	0.94	0.22	0.59
Control Mean - High Agency	0.37	0.96	0.49	0.14	0.34	0.96	0.25	0.61
Panel D - By Couple's Relationship Quality								
Low Relationship Quality	0.057 (0.046)	-0.006 (0.025)	-0.007 (0.044)	-0.042 (0.042)	0.034 (0.048)	0.004 (0.023)	-0.027 (0.040)	0.076 (0.052)
N	1316	1316	1316	1316	1316	1316	1316	1316
High Relationship Quality	0.038 (0.045)	-0.027 (0.022)	0.025 (0.037)	0.062 (0.045)	0.049 (0.045)	-0.024 (0.024)	0.048 (0.042)	0.092* (0.051)
N	1312	1312	1312	1312	1312	1312	1312	1312
Wife - Husband (Low Quality, p)	0.63	0.66	0.62	0.03				
Wife - Husband (High Quality, p)	0.81	0.90	0.19	0.56				
Control Mean - Low Quality	0.29	0.95	0.33	0.14	0.27	0.95	0.23	0.61
Control Mean - High Quality	0.30	0.97	0.30	0.16	0.27	0.96	0.23	0.60

Notes: The dependent variables are livestock, harvest, business, and wage labour at the extensive margin. The columns *Wife* and *Husband* indicate the heterogeneous effect of the cyclone shock on female and male labour activities, respectively. Panel A, rows *Nsanje* and *Mangochi*, indicates the effect of the cyclone shock on respondents' residing in Nsanje and Mangochi labour activities, respectively. Panel B, rows *Low Frequency* and *High Frequency*, indicates the effect of the cyclone shock on respondents' labour activities of those reporting flooding once every 5 or more years and either annually or biannually, respectively. Panel C, rows *Low Agency* and *High Agency*, indicates the effect of the cyclone shock on respondents' labour activities of those living in households where the wife reports below average and above average agency, respectively. Panel D, rows *Low Relationship Quality* and *High Relationship Quality*, indicates the effect of the cyclone shock on respondents' labour activities of those living in households where the wife reports below average and above average relationship quality, respectively. Livestock and harvest labour are reported by the male on their own and their wife's behalf, while business and wage labour are reported individually. Row *Wife - Husband (dimension, p)* represents the p-value of the effect on female's labour activities relative to male's along the respective heterogeneous dimension. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Only estimations including relief as a control are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

Appendix G Rainfall damage variable shown spatially

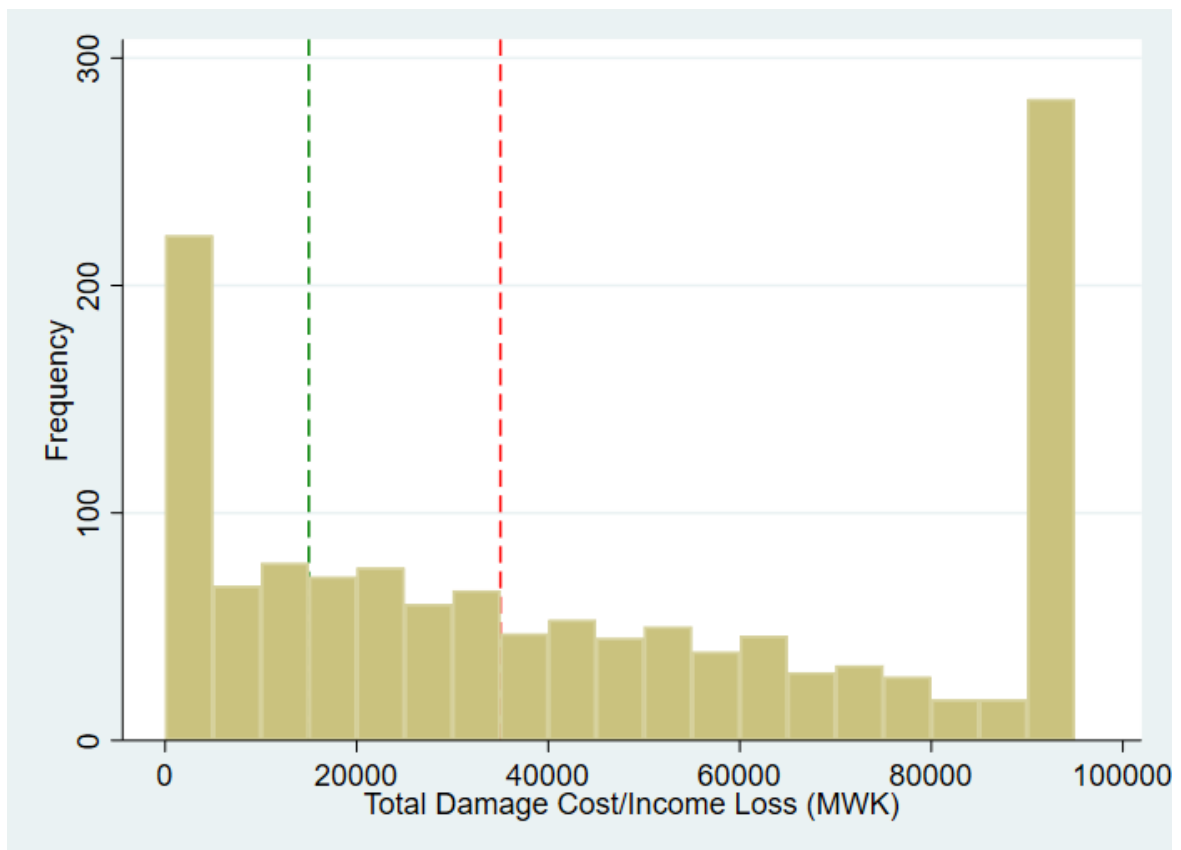
Figure G.1: Village Rainfall March 2019 Standard Score from Long-term Mean



Appendix H Relief

While there was a humanitarian response in Malawi, the event report noted significant challenges due to damaged roads and main access bridges being washed away as a result of heavy rain. This is evident in our data: in Nsanje (which received the most rain), only 73 households (11%) received relief, while in Mangochi 197 (29%) received relief. Receiving any sort of relief has a low positive correlation with total damage cost/income loss (0.213). This suggests that relief was only weakly targeted toward damage. To examine this further, 669 households (50.91%) met our definition of high loss (damage cost/income loss above 37,000 MWK), while 645 (49.09%) did not. Of high-loss households, 194 (29%) received relief, and of low-loss households, 76 (11.78%) received relief. Reporting of damage also raises a concern about bias if reported losses are thought to be linked to relief (i.e. there is an incentive to report greater losses if relief is expected to correspond to reported damage). If this were the case, we should see bunching around known relief amounts. 15,000 MWK is equivalent to the cash transfer provided to households under the government social cash transfer, and 35,000 MWK is the relief amount provided by the government to households that experienced damage. Figure H.1 shows no bunching around either amount, which is inconsistent with over-reporting tied to anticipated relief. One feature of the histogram is the rise and fall across adjacent 5,000 MWK bins (including the lower bound but excluding the upper bound); we suspect this reflects rounding of reported losses to the nearest 10,000 MWK.

Figure H.1: Histogram of Total Damage Cost/Income Loss. The bins are 5000MWK with the lower bound included and the upper bound excluded (i.e. 0-5000 includes 0 but not 5000). The last bin includes all remaining entries after 95000MWK. The green and red vertical dotted lines mark 15000MWK and 35000MWK, respectively. The former is equivalent to the cash transfer provided to households under the government social cash transfer while the latter is the relief amount provided by the government to households that experienced damage.



Appendix I Continuous measure of damage

Table I.1: Effect of Total Damage Cost/Income Loss (Continuous) on Mental Health

	Depression		Stress-related Disability		Self-efficacy	
	(1)	(2)	(3)	(4)	(5)	(6)
Panel A - Full Sample						
Total Damage Cost/Income Loss (1,000 MWK)	0.001 (0.003)	-0.000 (0.003)	0.002 (0.002)	0.002 (0.002)	-0.003** (0.001)	-0.003* (0.001)
Panel B - By Gender						
Wife	0.006 (0.004)	0.005 (0.004)	0.004** (0.002)	0.004* (0.002)	-0.005*** (0.002)	-0.005*** (0.002)
N	2640	2640	2640	2640	2640	2640
Husband	-0.006 (0.005)	-0.007 (0.005)	-0.000 (0.002)	-0.000 (0.002)	0.000 (0.002)	0.000 (0.002)
N	2628	2628	2628	2628	2630	2630
Wife - Husband	0.01	0.01	0.00	0.00	-0.01	-0.01
Wife - Husband (p-value)	0.02	0.01	0.06	0.07	0.00	0.00
Control Mean - All	43.97	43.97	22.12	22.12	22.15	22.15
Control Mean - Wife	42.37	42.37	21.56	21.56	22.40	22.40
Control Mean - Husband	45.57	45.57	22.67	22.67	21.90	21.90
Individual FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Controls	No	Yes	No	Yes	No	Yes

Notes: The dependent variables are individually-reported depression, stress-related disability, and self-efficacy. The depression and stress-related disability variables are reverse-coded so that higher values indicate lower levels of depression and stress-related disability (i.e., for all variables, higher scores correspond to better mental health outcomes). Panel A indicates the effect of cyclone damages (expressed in 1,000 Malawian Kwacha (MWK) and its 2019 nominal terms) on the entire sample's mental health variables. Panel B rows *Wife* and *Husband*, indicate the effect of cyclone damages on females' and males' mental health variables, respectively. The number of observations are those that contribute to the corresponding estimation (individuals in 2018 and 2019). Rows *Wife-Husband* and *Wife-Husband (p-value)* represent the effect on females' mental health relative to males' and the corresponding p-value, respectively. Control means of each mental health variable for the entire sample as well as the female and male subsamples are presented. All specifications control for year, individual, and household fixed effects as well as individual and household controls. Estimations with and without relief controlled for are presented. Standard errors clustered at the village level are in parentheses. * p<0.10, ** p<0.05, *** p<0.01.