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Weather shocks and resilience to food insecurity: Exploring the role of gender and kinship norms

Immacolata Ranucci [a,*], Donato Romano [a], Luca Tiberti [a,b]

[a] University of Florence, Department of Economics and Management, Italy
[b] Partnership for Economic Policy (PEP), Nairobi, Kenya

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ABSTRACT

Social and cultural institutions interact with environmental and individual factors, shaping resilience to external shocks. This study examines the interplay between gender-differentiated land management, kinship norms, and the effects of droughts on agricultural households' resilience to food insecurity in rural Malawi. Female land-managed households in Matrilineal-Matrilocal villages show higher resilience with respect to other communities. However, in times of drought, these households turn out to be less resilient to food insecurity than their counterparts in other areas. In support of this result, we find evidence that, when faced with drought, female land-managed households in Matrilineal-Matrilocal communities exhibit lesser involvement in more lucrative non-farm activities and a larger decrease in livestock. The study highlights the need to consider socioeconomic, cultural, and environmental factors interactions when assessing resilience and advocates for intersectional policies enhancing women's resilience.

1. Introduction

Women play a key role in guaranteeing crop production and households' access to food and nutrition security (Doss et al., 2014; Njuki et al., 2016). However, their ability to contribute to household food security is hampered by many economic, social, and cultural constraints (Quisumbing et al., 1995). Socio-cultural norms and practices differentially affect men's and women's vulnerability by defining gender differences in the access to and distribution of resources, decision-making power, knowledge, and skills (Jordan, 2018; Nelson & Stathers, 2009; Rao et al., 2019; Sugden et al., 2014). In agrarian communities, gendered cultural norms can define who makes farm management decisions, such as the crop mix to be produced and output destination, discriminating against women (Jayachandran, 2015). Culturally based gender gaps in land ownership and access may contribute to magnifying existing gaps in access to credit and other productive inputs, reinforcing gender disparities in wellbeing outcomes such as food security. In addition, weather shocks differentially affect genders (Bryan et al., 2024; IPCC, 2014; Kristjanson et al., 2017), therefore contributing to gender-related differences in households' resilience to food insecurity (McKune et al., 2015; Ramachandran, 2013).[1] In particular, social norms prescribing different behaviors, decisions, and roles based on gender can play a key role in determining adverse weather shock impacts on women with potential consequences on the whole household, depending on their role.

While it has become common wisdom that social norms shape the way local communities respond to adverse weather events (Carmen et al., 2022; Jones & Boyd, 2011; Rao et al., 2020), the evidence on how such norms and customs mediate the impacts of weather shocks on households is still limited. Therefore, we aim to investigate how gendered customary kinship norms of inheritance and post-marital residence interact with weather shocks and gender differences in land management in determining the household's resilience to food

* Correspondence to: Via delle Pandette 9, 50127 Florence, Italy.
E-mail addresses: immacolata.ranucci@unifi.it (I. Ranucci), donato.romano@unifi.it (D. Romano), luca.tiberti@unifi.it (L. Tiberti).

[1] On the one hand, women's higher vulnerability to shocks is determined primarily by gender gaps in land ownership and control over productive assets (Agarwal, 1994) that lead to allocative inefficiencies and foregone economic output (O'Sullivan, 2017). On the other hand, land tenure security contributes to mitigating the negative effect of weather shocks on food security (Ajefu & Abiona, 2020), since land and non-transferable assets are often used as collateral to access credit (Deininger & Castagnini, 2006).

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insecurity. We adopt the (Barrett & Constas, 2014) approach who define resilience with reference to a normative condition as "the capacity over time of a person, household or other aggregate units to avoid poverty in the face of various stressors and in the wake of myriad shocks. If and only if that capacity is and remains high over time, then the unit is resilient" (p. 14626).[2]

We use panel data from the Malawi Integrated Household Survey collected in 2010, 2013, and 2016, including detailed food consumption information, and combine them with grid-level weather data. Upon controlling for temporal and spatial fixed effects, we estimate an OLS estimator to assess the interplay between kinship norms and weather shocks (proxied by drought) on the gender gap in resilience to food insecurity. Kinship norms relevant for gender-differentiated access to land in this context are the combination of post-marital residence and lineage customs (Lovo, 2016). By matrilocal (patrilocal) custom, we mean the tradition prescribing that a newly married couple resides with the wife's (husband's) kinship. With a matrilineal (patrilineal) system, we mean that the lineage is transmitted to female (male) descendants.[3] Therefore, households in Matrilocal-Matrilineal (MM) communities constitute the treatment group as opposed to all non-MM combinations. The identification of drought relies on the temporal and spatial variability of the Standardized Precipitation Evapotranspiration Index (SPEI). Food security outcomes include the Food Consumption Score (FCS), an indicator of diet quality, and the Household Dietary Diversity Score (HDDS), an indicator of diet diversity. We adopt the conditional moment-based approach proposed by Cissé and Barrett (2018) to estimate household-specific resilience scores based on the food security outcomes.[4] This method performs better than other resilience indicators that rely on data reduction methods (Upton et al., 2022). Social norms are defined as the prevalent locality and lineage norm in a given community (MM vs. non-MM) based on a time-consistent definition of the current norm measured at the village level. This allows for transitions between different kinship norms over time.[5]

We chose Malawi for our empirical analysis because it allows us to exploit a significant intra-national variability in kinship norms of inheritance (lineage) and post-marital residence. In fact, Malawi is part of the so-called *Matrilineal Belt*, an area characterized by ethnic groups following female-biased inheritance and residence norms. Interestingly, in Malawi different cultural norms coexist, making this country an ideal setting to study the role that these norms play in determining economic outcomes like gender-biased land tenure insecurity (Lovo, 2016) and the gender-differentiated effect of weather shocks on households' welfare (Asfaw & Maggio, 2018). Moreover, residency norms (matri- or patri-locality) contribute to shaping intra-household allocation of resources, thus affecting women's risk of poverty (Aminjonov et al., 2023). At the same time, Malawi is exposed to many different weather shocks - such as floods and droughts - that have been increasing in frequency, intensity, and impact over the last decades, making the issue of building resilience to weather shocks a legitimate policy objective in the country.

Our results show that households residing in Matrilineal-Matrilocal villages generally present higher resilience to food insecurity. We found, however, an ambiguous relationship between kinship norms and gender gaps in resilience. On the one hand, households with female land management are more likely to have adequate dietary diversity (measured as HDDS) in MM communities than in non-MM communities. This finding is consistent with the literature emphasizing that women in MM communities are better off than those living in patriarchal contexts. Furthermore, we find that female land management is generally associated with higher households' resilience than male land management when a drought hits them. However, when we account for cultural norms, households with female land management in MM communities are less resilient to drought than similar households in non-MM communities. Our results are robust to several checks. We also provide suggestive evidence that potential mechanisms driving our results relate to kinship norms-related differences in the allocation of working time between agricultural and non-agricultural activities, and in the livestock dynamics. Yet, results are less conclusive when the food consumption score indicator is used.

Our paper contributes to the literature in several ways. First, we provide further evidence that food security relates to socio-cultural factors. As social structures constitute a key determinant of wellbeing outcomes of different groups within a given population (Molnar, 1999), it is essential to understand that gender norms and family structures play a crucial role in shaping gender disparities in food insecurity. This impact is both direct, involving gender-differentiated prescriptions and recommendations about food intake and food-related behaviors, and indirect, through non-food related prescriptions (*e.g.*, restriction to women movements that can limit their access to diverse food) (Briones Alonso et al., 2018). In our case, we argue an indirect mechanism is at work via prescriptions for land access and utilization and we test whether gender-differentiated land management is associated with different levels of resilience to food insecurity in communities following different cultural norms.

Second, we document that the interplay between socio-cultural and gendered norms is associated with different patterns in household resilience. Resilience is an intrinsically intersectional concept (Chisty et al., 2021; Dasgupta et al., 2010; Phuong et al., 2023). As stressed by Béné et al. (2016), resilience is "socially constructed" (p.166) and culturally embedded. The intersectional approach is particularly suitable to highlight how social and cultural institutions interplay with environmental and individual factors in shaping people's ability to cope with exogenous shocks. Indeed, resilience is determined not only by economic power and opportunities but also by social and cultural factors (Weichselgartner & Kelman, 2015). In particular, understanding the dynamic relationship between socially induced discriminations – mediated by gender differences in land ownership/management – and household food security contributes to shedding light on wellbeing outcomes in risk-prone contexts, providing insights on targeting interventions and designing welfare-enhancing policies. Furthermore, the relationship between gendered socio-cultural practices and resilience is crucial to understanding and addressing the power relationships based on resilience differentials, as cultural norms can enhance resilience or make individuals more vulnerable (Jordan, 2018).

Third, we also contribute to the literature on the relationship between social norms and gender gaps in land management. In Sub-Saharan Africa, land is often managed through customary tenure systems based on various cultural practices. Lovo (2016) stresses the importance of both lineage transmission and post-marital residence in determining men's and women's security over land and productive assets in such contexts. In recent times, there has been increased attention in economics to focus on the effect of cultural norms and institutions on development (Baland et al., 2020; Nunn, 2020). Bau and Fernández (2021) emphasize the importance of the interplay between culture and the family institution, recognizing that the family is a fundamental economic unit central to production and distribution and plays a primary role in shaping social beliefs as the initial transmitter of such values. Particular attention has been devoted to the link

[2] For a more in-depth discussion of development resilience in agrarian settings and with respect to food security, see Annex A.1.

[3] See Annex A.2 for details on gender-biased kinship norms and wellbeing, in general and with specific reference to Malawi.

[4] A step-by-step procedure for model specification is reported in Annex A.3.

[5] Previous works analyzing social norms relied on: ancestral norms assigned through ethno-linguistic affiliation at the household level (Aminjonov et al., 2023); districts' classification based on ethnic group domination (*i.e.*, more than 50% of the villages) using the 2007 National Census of Agriculture and Livestock (NACAL) (Asfaw & Maggio, 2018; Berge et al., 2014); or the current prevalent norm in the village (Lovo, 2016). To the best of our knowledge, our definition of social norms is the first to adopt a definition which reflects the transition of social norms over time.

between gender disparities in socio-economic outcomes and variations in traditional family structure (Jayachandran, 2021). Gender-biased ancestral norms regulating marriage patterns and living arrangements (*e.g.*, endogamy or patrilocality), the transmission of lineage and inheritance (*e.g.*, patrilineality), and marriage payments (dowries or bride price) have been studied concerning individual poverty (Aminjonov et al., 2023; Calvi & Keskar, 2021), inter-generational transfers (La Ferrara, 2007), health and education (Dessy et al., 2023; Loper, 2019; Lowes, 2022), vulnerability to weather shocks and wellbeing (Asfaw & Maggio, 2018), time of marriage and fertility outcomes (Corno et al., 2020; Lowes & Nunn, 2018), and domestic violence (Alesina et al., 2021; Lowes, 2022; Lowes & Nunn, 2018). However, to the best of our knowledge, the role of gender-based kinship norms in shaping the relationship between weather shocks and households' food insecurity has not yet been explored.

Two main takeaways arise from our results. First, regarding climate-induced food insecurity, resilience capacity is not gender-neutral, and the gendered patterns triggered by weather shocks can be different from those observed in contexts not hit by these shocks. Second, socio-cultural norms are pivotal in shaping these different gender-specific resilience patterns by defining vulnerability mechanisms and coping behaviors. Including the social-cultural norms' role in designing policy interventions is critical to improving female farmers' access, entitlement, and utilization of resilience-enhancing skills, assets, and knowledge and, therefore, to achieving food security for some of the most vulnerable households. Off-farm employment and income diversification may become particularly important when weather shocks threaten agricultural productivity. Improving women's access to off-farm employment opportunities is crucial. Still, policymakers must account for the role of social norms that limit women's sectoral mobility and, if unaccounted for, can make the policy interventions ineffective. Different socio-cultural norms in Malawi appear to contribute to how specific risk management and risk coping strategies, such as work activity allocation and livestock management, are adopted.

The remainder of the paper is organized as follows. Section 2 presents the data, describes the data preparation process, and provides some summary statistics of the population under scrutiny. Section 3 presents the econometric approach, describing the models used to estimate the relationship between resilience, gender, kinship norms, and weather shocks. Section 4 discusses the main results, presents several robustness checks, and explores some mechanisms to explain our results. Section 5 concludes, highlighting the policy implications, discussing the limits of the analysis, and advancing some proposals for future research.

2. Data

2.1. Data sources and preparation

Data source We use household-level data from the Malawi Integrated Household Panel Survey (MIHPS) 2010-2013-2016 that the Government of Malawi conducted through the National Statistical Office (NSO) under the technical and financial assistance of the Living Standards Measurement Study - Integrated Surveys on Agriculture (LSMS-ISA) project of the World Bank, funded by the Bill and Melinda Gates Foundation (NSO, 2020).[6] The MIHPS Program started by implementing the Third Integrated Household Survey (IHS3) in 2010/11. Households were selected with a stratified two-stage sample design to be representative at the national and rural/urban levels (NSO, 2012). A sample of 3246 households from IHS3 was then selected for the panel survey. The Integrated Household Panel Survey (IHPS) 2013 was implemented to track and re-interview households that were previously interviewed during the IHS3, plus the new households of tracked split-off individuals, with a total panel sample of 4000 observations that could be traced back to 3104 baseline households, with an overall attrition rate of 3.78% (NSO, 2014). The Fourth Integrated Household Survey (IHS4) was conducted in 2016/17. Out of 1989 households selected from the previous round, 1908 were reached to be interviewed (4% attrition rate), for a total of 2508 households (Sample 0 in Table 1) given by the sample expansion through the tracking of split-off individuals and the new households that they form (NSO, 2017).

Table 1
Number of observations after the application of each selection criteria.

Criteria applied	Survey round				Name
	2010	2013	2016	Total	
Original panel (unbalanced)	1619	1990	2508	6117	SAMPLE 0
1. Rural households	1144	1434	1841	4419	SAMPLE 1
2. Agricultural households[a]	1085	1312	1672	4069	SAMPLE 2
3. Consumption recorded by 31Oct[b]	1085	1312	1377	3774	SAMPLE 3
4. Observed in 2 rounds[c]	1068	1296	1097	3461	SAMPLE 4
5. No Joint Land Management[d]	867	1132	848	2847	SAMPLE 5

[a] Agricultural households are those who report to own or cultivate some land.
[b] Consumption recorded after October 31 following the reference (previous) rainy season (November-April) would fall into the new rainy season.
[c] Households not observed in at least two consecutive rounds are eliminated.
[d] Keep only households whose whole land (meaning every plot) has either men or women as first managers and are observed at least in two consecutive rounds.

Sample selection The sample for the analysis is selected by applying the following criteria (Table 1): (i) households resident in rural areas; (ii) owning or cultivating plots (agricultural households); (iii) with consumption recorded by November after the end of the reference rainy season[7]; (iv) observed at least in two consecutive survey rounds.[8] The four conditions above define the so-called Sample 4, which is our preferred sample. We also include an additional criterion, based on the land management definition, in the main analysis (see next section). Criterion (iii) ensures that we only consider households interviewed before the start of the next rainy season, which might affect the outcomes of interest. Criterion (iv) is necessary as we measure resilience as the probability of being above the food security threshold given, among other things, the previous level of food security achieved.

Table B1 shows that, for the sample defined only by the first three criteria, the probability of being observed in two consecutive rounds is positively correlated with residing in an MM village and with higher levels of the SPEI-6 index, which captures climatic conditions (see below). However, the same logistic regression performed after excluding households that have split over time shows no correlation with weather conditions and a strong correlation with the kinship norm: households in MM communities are more likely to be observed continuously.

[6] We did not include the 2019 wave for two main reasons. First, between 2017 and 2018, Malawi was affected by another significant drought. Incorporating the 2019 wave would mean accounting for households that experienced double exposure to droughts, specifically the severe 2015–2016 drought and the subsequent one in 2017–2018. This would complicate the interpretation of our results, as it introduces an additional layer of exposure that is difficult to disentangle from the effects of the earlier drought. Second, adding more waves increases the risk of data quality deterioration due to attrition. The earlier waves, have higher data quality and lower attrition rates, making them more reliable for robust analysis. Being closer to the baseline year 2010 provides stronger comparability and allows us to estimate household-level fixed effects with fewer concerns over missing or inconsistent data.

[7] The rainy season goes from November to April. Most of the agricultural production is done during the rainy season. Households whose consumption is recorded after October 31st would have already entered a new rainy season, potentially affecting their consumption levels.

[8] Therefore, our sample includes households observed in all three rounds (2010, 2013, and 2016) as well as households observed only in two consecutive rounds (2010–2013 or 2013–2016).

Column (3) of the same table shows that the probability of splitting, indeed, is positively correlated with being a household whose land is jointly managed by men and women, and negatively correlated with weather conditions and MM norms. Therefore, one of the reasons why households in MM villages are more likely to be observed at least twice is that they are less likely to split. Therefore, the IHS panel weights provided with the dataset by the World Bank are recalculated for each round, considering attrition to take into account the sample's partial self-selection. Moreover, our estimates always control for households that split between the first and second survey rounds and for those that split between the second and third rounds.

Definition of land management The Malawi IHS collects information about the households' agricultural production. We know the first manager for each plot owned or cultivated by the household. According to the definition provided in the IHS questionnaire, the plot manager is the person who makes decisions about the crops to be planted, input use, and timing of cropping activities.[9] Since a household can own or have access to more than one plot – on average, 3.8 plots per household – we are interested in land management where a household's land is intended as the sum of all the plots a household manages. Therefore, considering only the first manager of each plot, the following combinations are possible:

- Male land management: all cultivated plots have a man as the first manager (57.6% of Sample 4);
- Female land management: all cultivated plots have a woman as the first manager (32.9% of Sample 4);
- Joint land management: some plots have a man as the first manager and others have a woman (9.5% of Sample 4).

For the main analysis, the households whose land is jointly managed (based on the first manager only) are excluded from the sample: this is the fifth criterion applied, which defines Sample 5 of Table 1.

As female land management may be related to female household headship and the absence of adult males (see Table B4), we account for these factors in our robustness checks to strengthen the validity of our results.

Non-random assignment of land plots among household members Even within a group sharing common norms about who is supposed to be in charge of the land, plot allocations between family members may follow cross-cutting logics that take into consideration other factors (such as age, gender, position relative to the head of the household, etc.) in deciding which among the family members should manage a particular plot of land. In Malawi, male land management is common within Matrilineal communities even though customary norms would make women inherit the land.[10]

First, we show that our sample, analyzed at the plot level, presents a relatively high persistence of gender-differentiated management, as shown in Table B3: about 65% of the plots tracked in all three survey rounds have been managed by a household member of the same gender over time, and 61% of plots are managed by the same person. The probability of maintaining gender-uniform management over time for every single plot is generally high, even though plots in MM communities change the manager's gender slightly more often (Figure B1). Furthermore, gendered land management does not seem affected by the weather shock (Table B5).

Definition of kinship norm The kinship norm is measured at the village level. The IHS community questionnaire includes a question about the prevalent type of marriage in the community (baseline EA) with the following response options: matrilineal and neolocal, matrilineal and matrilocal, matrilineal and patrilocal, patrilineal and neolocal, patrilineal and patrilocal, or other.[11] Following (Lovo, 2016), we expect female land managers to be more resilient in Matrilineal-Matrilocal (MM) communities. However, analyzing the data across the three-panel rounds, the prevalent marriage type in the community is not always time consistent[12] as shown in the first part of Table B6. Table B7 reports how many times communities report a different prevalent norm during the three survey rounds, by disaggregating lineage from post-marital residence practice: while the lineage is mostly stable over time, with 76% of the EAs never changing their norm, the prevalence of a particular post-marital residence norm is much more transitory and overall determines the frequent changes in the norm when we consider the two cultural practices together. To account for this time inconsistency, we build an indicator for the kinship norm that takes the value 1 only for households residing in communities where the community representative reported "Matrilineal-Matrilocal" as the prevalent norm within the village in all three rounds, corresponding to 31 enumeration areas. Fig. 1 shows the spatial distribution of EAs classified according to current and time-consistent norm definition. Time-consistent MM communities are compared to any other type of prevalent norm, including the MM ones that are not time-consistent, as we assume that women face lower levels of authority and security in all these other cases.[13]

The sample used in the main analysis includes households that, in the second or third rounds of data collection, moved from the original location they were selected in. These households have been tracked and re-interviewed in their new location, but we do not have information at the community level for their new village of residence. Our choice relies on the assumption that households that move from a Matrilineal-Matrilocal village preserve their culture even if the new community might follow different kinship norms. Reassuringly, as shown in Table 2, these households account for less than 5% of our sample. We will check the robustness of this assumption by excluding the households moving between rounds.

Definition of food security indicators Food security, our outcome of interest, is measured with two different indicators: the Food Consumption Score,[14] which is an indicator of diet quality and a proxy indicator of household caloric availability (Leroy et al., 2015), and the Household

9 The plot manager is not necessarily the owner or the person who decides how to spend the income from selling the crops produced on that plot.

10 This phenomenon can be largely ascribed to a male-biased prejudice already introduced during the colonial period and then reinforced by the *Lilongwe Land Development Programme* (LLDP), funded by the World Bank to support the implementation of the Malawi Registered Land Act in 1967, that assumed male headship of the household also in Matrilineal-Matrilocal settings and, consequently, entitled land to male household heads (Djurfeldt et al., 2018).

11 The category "other" is included in the set of possible answers to capture all those forms that do not exactly correspond to previous options. For example, if the community follows neither matrilineal nor patrilineal inheritance rules, all the other options would not apply. As shown in Table B6, the number of communities falling in this category is very low, but increasing over time.

12 Transitions between different traditional systems are not uncommon and are well documented in the anthropological literature (Shenk et al., 2019)

13 However, in the robustness checks we control for an alternative definition of the kinship norm (Berge et al., 2014) and specifications to account for potential respondents' bias due to preferences in favor of the norm practiced by their own group (see Annex A.5).

14 The Food Consumption Score (FCS) considers eight food groups – staples; pulses; vegetables; fruits; meat and fish; milk products; sugar; and oils and fats – consumed by the household in the week before the interview. The FCS is the sum of the number of days that food items from each of these food groups were consumed, weighted by a coefficient representing the nutritional quality of each food group (World Food Programme, 2008). Based on this score, a household's food consumption can be classified as poor ($FCS <= 21$), borderline ($21.5 < FCS <= 35$), or acceptable ($FCS > 35$).

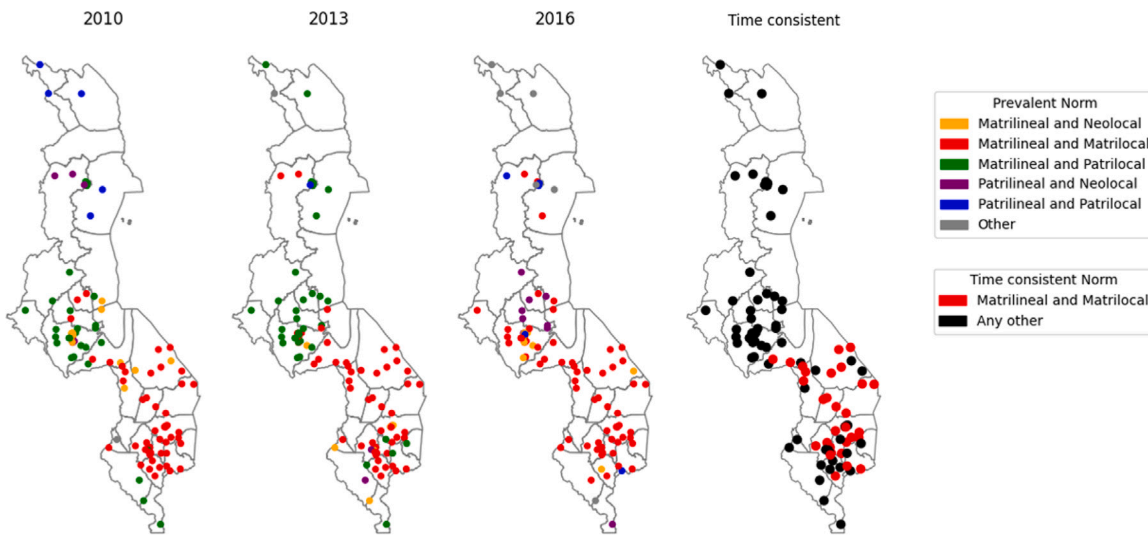

Fig. 1. Geographical distribution and temporal variation of cultural norms.
Source: Authors' elaboration from Malawi IHS. Points on the maps correspond to the Enumeration Areas of the Malawi IHS.

Table 2
Summary statistics.

	2010			**2013**			**2016**			Pooled		
	N.	mean	sd	N.	mean	sd	N.	mean	sd	N.	mean	sd
Food Consumption Score	1068	45.43	12.73	1296	45.76	12.23	1097	42.12	13.22	3461	44.55	12.83
Household Dietary Diversity Score	1068	8.21	2.14	1296	8.35	2.12	1097	7.45	1.90	3461	8.03	2.10
SPEI-6	1068	−0.16	0.45	1296	0.18	0.50	1096	−1.22	0.69	3460	−0.37	0.78
Drought (SPEI-6 −1.5)	1068	0.00	0.00	1296	0.00	0.00	1097	0.37	0.48	3461	0.11	0.31
Flood (SPEI-6 > 1)	1068	0.02	0.14	1296	0.10	0.30	1097	0.00	0.04	3461	0.04	0.19
SPEI-6 in the year before the survey	1068	−0.27	0.49	1296	−0.62	0.41	1096	−1.39	0.53	3460	−0.70	0.67
Drought in the year before the survey	1068	0.00	0.00	1296	0.00	0.00	1097	0.50	0.50	3461	0.15	0.35
Norm (1 = Matrilineal-Matrilocal)	1068	0.36	0.48	1296	0.35	0.48	1097	0.31	0.46	3461	0.35	0.48
Land Management (LM):												
– Female LM (1st manager)	1068	0.28	0.45	1296	0.33	0.47	1097	0.39	0.49	3461	0.33	0.47
– Joint LM (1st manager)	1068	0.10	0.30	1296	0.09	0.29	1097	0.10	0.30	3461	0.10	0.30
– Female LM (1st and 2nd manager)	0	.	.	1296	0.27	0.45	1097	0.29	0.45	2393	0.28	0.45
– Joint LM (1st and 2nd manager)	0	.	.	1296	0.55	0.50	1097	0.56	0.50	2393	0.55	0.50
Household size	1068	4.89	2.20	1296	5.09	2.24	1097	5.05	2.17	3461	4.99	2.20
Dependency ratio	1068	0.50	0.23	1296	0.51	0.23	1097	0.48	0.23	3461	0.50	0.23
Female-headed household	1068	0.24	0.43	1296	0.27	0.45	1097	0.29	0.46	3461	0.27	0.44
Household head's age	1068	42.90	16.55	1296	46.08	16.11	1097	47.27	15.70	3461	45.09	16.29
Average adults' education	1068	4.76	3.15	1294	5.03	3.06	1097	5.25	2.92	3459	4.98	3.07
Split between 2010 and 2013	1068	0.00	0.00	1296	0.18	0.39	1097	0.00	0.00	3461	0.05	0.22
Split between 2013 and 2016	1068	0.00	0.00	1296	0.00	0.00	1097	0.18	0.39	3461	0.05	0.23
Income earner left	1068	0.00	0.00	1296	0.04	0.20	1097	0.05	0.23	3461	0.03	0.17
Different location from baseline	1068	0.00	0.00	1296	0.04	0.20	1097	0.06	0.23	3461	0.03	0.17
Wealth index	1068	1.72	0.75	1296	1.78	0.76	1097	1.75	0.75	3461	1.74	0.75
Arable land (ha)	1068	0.74	0.64	1296	0.70	0.62	1097	0.76	0.70	3461	0.74	0.65
SDI for crop diversification[a]	1054	4.24	6.74	1277	5.03	5.87	1084	7.02	9.41	3415	5.28	7.50
Intercrop	1054	0.34	0.47	1277	0.41	0.49	1084	0.36	0.48	3415	0.36	0.48
Livestock owned in TLU[b]	1068	0.19	0.75	1296	0.25	1.35	1097	0.19	0.71	3461	0.21	0.95
Free Maize Programme	1068	0.01	0.12	1296	0.14	0.35	1097	0.14	0.34	3461	0.09	0.28
Free Food (other than maize) Programme	1068	0.02	0.14	1296	0.10	0.31	1097	0.09	0.28	3461	0.06	0.25
Food/Cash-for-work Programme[c]	1068	0.02	0.15	1296	0.17	0.38	1097	0.08	0.28	3461	0.08	0.28
Child Feeding Programme[d]	1068	0.13	0.34	1296	0.17	0.38	1097	0.14	0.34	3461	0.15	0.35

Author's calculations from Sample 4 selected from the IHS panel. The table reports the number of observations, mean values, and standard deviations. Observations are weighted with panel sampling weights provided by LSMS-ISA.

[a] Simpson Diversity Index (SDI) for crop diversification.

[b] Livestock holdings are measured in Tropical Livestock Units (TLU) with sub-Saharan Africa-specific conversion factors.

[c] Food/Cash-for-Work Programme from 2013 includes both MASAF and non-MASAF programs.

[d] Child feed Programmes include School Feeding, Targeted Nutrition, and Supplementary feeding for the malnourished.

Dietary Diversity Score,[15] which provides information household's diet diversity and is a proxy of household's ability to access food (Kennedy et al., 2011). Figure B2 shows the distribution of the outcome variables. They are both assumed to be Gamma distributed as this distribution represents the skewness of food security indicators better than a normal distribution.

Definition of drought The IHS provides geographical positioning system (GPS) coordinates for each enumeration area at the baseline and updates coordinates for households that moved in following waves. To protect the confidentiality of the sampled households and communities, the GPS coordinates are averaged at the enumeration area level, with a buffer for rural enumerator areas of 0–5 km. GPS coordinates (latitude and longitude) allow matching household- and community-level variables with climatic data. An indicator for drought is built using the Standardized Precipitation Evapotranspiration Index (SPEI) provided by the Global Drought Monitor (Vicente-Serrano et al., 2010), which is matched with household-level observations through GPS coordinates. The reference month used for the SPEI is April, the end of the rainy season in Malawi. For a graphical representation of the temporal sequence between the shock and the household-level socio-economic variables (including the outcome measurement), we provide a timeline in Figure B3. We use the 6-month SPEI, which is able to capture agricultural droughts as it entirely covers the rainy season (November-April). SPEI data are provided with a spatial resolution of 1° (grid). Figure B4 represents the distribution of SPEI-6 across the three rounds for MM and other communities and shows that the 2015–16 drought was extremely severe and affected most of the population. For this reason, we build a dummy variable for the drought equal to 1 when SPEI-6 < -1.5 and 0 otherwise.

2.2. Descriptive statistics

Table 2 reports summary statistics for the main variables of interest. Food security indicators worsened in 2016 with respect to the previous survey rounds. In the same year, 36% of households were hit by drought. About one-third of households have plots whose first manager is always a woman. Female land management seems to increase over time (from 28% in 2010 to 39% in 2016). About 35% of the sampled households live in villages where the prevalent norm is MM.

Looking at differences between MM communities and other communities (Table B9 shows statistics for years 2013 and 2016 only), we see that the former are more severely hit by drought. As expected, female land management is also more common in MM areas (43% of households vs. 32% in other communities). Households in MM villages cultivate less land and own less livestock,[16] but have more crop variety and are more likely to practice intercropping. Breaking down our sample into three wealth groups, households in MM communities are generally less wealthy and more involved in social assistance programs.

Table B10 compares households with female land management and households with male land management. Households whose land is entirely managed by men show higher scores of food security indicators, are less exposed to droughts, and, on average, are larger and more educated households with younger heads. Households with male land management are wealthier, cultivate more land, and have higher cropping diversity. Interestingly, there are no significant differences in livestock ownership.

[15] The Household Dietary Diversity Score (HDDS) is calculated as the count of the number of different food groups consumed by any household members in the seven days before the interview. We consider 12 groups as proposed by Swindale and Bilinksy (2006): cereals; roots and tubers; pulses/legumes and nuts; vegetables; fruits; meat and poultry; fish and seafood; eggs; milk and dairy products; oil and fats; sugar, honey, and sweets; and miscellaneous.

[16] This is consistent with the anthropological literature on Malawi finding land scarcity in matrilineal areas (Holden et al., 2003; Radcliffe-Brown & Forde, 2015).

3. Empirical strategy

We aim to investigate whether kinship norms are associated with different weather shocks' impact on male and female land-managed households' resilience to food insecurity. Our hypothesis is that when facing a drought, households whose land is managed by women should have a resilience score closer to those of male land management households in MM communities than in any other community, *i.e.*, they show a smaller gender gap. This is because communities that practice matrilineality and matrilocality guarantee women access to material and immaterial resources (land and productive assets, kin support, etc.), and security over property. In a rural context where farming is the first source of livelihood for the large majority of households, these elements contribute to creating the conditions for better outcomes in terms of production and wellbeing (International Food Policy Research Institute, 2022). Moreover, as rainfed crop production is the primary economic activity (Benson & De Weerdt, 2023), weather shocks such as drought could potentially have devastating effects on agricultural outputs and, in turn, on households' wellbeing. Access to agricultural inputs, information, innovations, and security over land ownership and utilization are key to protecting against weather shocks and their aftermaths.

However, whether the higher authority and influence that women have in MM communities actually translate into higher resilience to food insecurity is a matter of empirical investigation that has not yet been studied in the literature. In fact, in case of shocks affecting farming activities, the probability that they can maintain adequate levels of food consumption and dietary diversity depends not only on access to resources or increased security of returns to investments but also on the ability to mobilize additional resources, counting on support networks, differentiating income sources and, in general, implementing effective coping strategies. The objective of our empirical analysis is thus to explore the relationship between food security and the possible interactions among three conditions, namely (i) different land management (female vs. male), (ii) the prevailing kinship norm in the community (MM vs. any other), and (iii) experiencing or not a drought.

We adopt a stepwise procedure, from the simplest model to the most complete, fully interacted specification (see Annex A.3). We first estimate a simple model with no interactions (Model A3.1), where the independent variables are the lag of the food security indicator (W), an indicator for the drought shock (D), an indicator for female land management (FLM), and the prevailing kinship norm in the community (N). Then, we estimate two models, each adding to the base model an interaction term between drought and land management variables (Model A3.2) and an interaction term between drought and the kinship norm (Model A3.3), respectively. In addition, to check the potential covariance between FLM and N, we add to the base model the interaction term between the land management and the kinship norm variables (Model A3.4). Moreover, we account for all potential interactions between our three key covariates by adding the three double interactions between D, FLM and N, plus their triple interaction (Model A3.5). Finally, to account for potential structural differences between Matrilineal-Matrilocal communities and others, we then estimate a model similar to Model A3.5 but where the norm fully interacts with all other covariates. This model (that we call Model A3.6 in Annex A.3) is specified as follows:

$$
\begin{aligned}
W_{icgmt} = & \sum_{\theta=1}^{3} \phi_\theta W_{i,t-1}^{\theta} + \beta_1 D_{gt} + \beta_2 FLM_{it} + \beta_3 N_c + \beta_4 D_{gt} \times FLM_{it} + \\
& + \sum_{\theta=1}^{3} \psi_\theta W_{i,t-1}^{\theta} \times N_c + \beta_5 D_{gt} \times N_c + \beta_6 FLM_{it} \times N_c \\
& + \beta_7 D_{gt} \times FLM_{it} \times N_c + \\
& + \delta_1 S_{it}^{13} + \delta_2 S_{it}^{16} + \delta_3 S_{it}^{13} \times N_c + \delta_4 S_{it}^{16} \times N_c + \\
& + \alpha_t + \alpha_m + \alpha_g + \sum_t \gamma_t N_c + \sum_m \gamma_m N_c + \sum_g \gamma_g N_c + \epsilon_{icgmt}
\end{aligned} \tag{1}
$$

where i denotes households, c indicates the community (enumeration area), g is a spatial indicator (grid) corresponding to SPEI resolution, m denotes the month in which (food) consumption is measured, and t indicates the year of the survey. All models include the lagged outcome and its quadratic and cubic transformation to capture potential non-linear dynamics (the polynomial terms of the lagged outcome also interact with the Norm). The variable D is an indicator equal to 1 if the household experienced a drought and 0 otherwise. The variable FLM is equal to 1 if all land plots are managed (first manager) by women and 0 if they are all managed by men.[17] N is the binary variable for the kinship norm, equal to 1 if the household's community is MM and 0 otherwise. S^{13} and S^{16} are dummy variables indicating if the household split between 2010 and 2013 or between 2013 and 2016. The terms α_t, α_m, and α_g are year, consumption month, and spatial (grid) fixed effects, respectively. Indeed, the identification of the effect of drought relies on their temporal and spatial variability in the sample after controlling for time and spatial fixed effects. As kinship norms in Malawi are generally spatially polarized (Dessy et al., 2023), grid-fixed effects should capture time-invariant factors that may correlate with them. However, grid-fixed effects explain only about half of the variation in kinship norms between households (Table B8), meaning that the norm variable does not capture only a geographical effect. We also conducted robustness checks to eliminate potential confounders (see Annex A.5). Furthermore, $\sum_t \gamma_t N_c$, $\sum_m \gamma_m N_c$, and $\sum_g \gamma_g N_c$ allow the three effects to depend on whether the community is prevalently MM. The error term is represented by ϵ. We use an OLS estimator, clustering standard errors at two levels: enumeration areas (EA) to capture the data design and household level to consider the parent household for split-offs.[18] Observations are weighted with households' panel weights provided by the Malawi IHS. Additional control variables will be added as robustness checks.

Household resilience is estimated according to the three-step procedure applied to panel data proposed by Cissé and Barrett (2018) (Annex A.4): first, the household-specific conditional wellbeing mean is estimated; second, the residuals are used to estimate the household-specific conditional variance; third, assuming a two-parameter distribution, the two estimated conditional moment functions are used to estimate the conditional probability of satisfying the normative wellbeing standard, which is the Resilience Score. Once we estimate the indicator- and threshold-specific RS, we are interested in estimating each factor's contribution to resilience, where factors are the covariates on which RS are conditioned. Therefore, the dependent variable, W, is, in turn: (i) the outcome variables that proxy food security (*i.e.*, FCS and HDDS) in the first relationship (Eq. A4.1) that estimates the household-specific conditional mean; (ii) the resilience scores RS, constructed as a conditional probability of satisfying some normative standards of wellbeing (Eq. A4.3). The inclusion of the lag of the dependent variable W follows (Cissé & Barrett, 2018), who estimate resilience as a household-specific probability of being above an adequacy wellbeing threshold at time t, conditioning it to the level of wellbeing at time $t-1$ and other factors of interest. The lag is added as a third-order polynomial to account for potential non-linear intertemporal dynamics in food security. For details on how the resilience score is estimated, see Annex A.4.

The estimation of resilience scores requires: (i) a distributional assumption for the indicator-specific probability density function, and (ii) the choice of thresholds indicating the adequacy level. As mentioned, we assume our food security indicators follow a Gamma distribution. The indicator-specific normative standards used to build resilience scores are the following thresholds:

- Food Consumption Score: $FCS > 35$ and $FCS > 44$, with the former being the official threshold and defining "borderline" food consumption status (World Food Programme, 2008), while the latter corresponds to the adequacy limit for rural Malawi according to Lovon and Mathiassen (2014);
- Household Dietary Diversity Score: $HDDS > 5$ and $HDDS > 7$, where the former threshold corresponds to the five groups (fruits, vegetables, pulses, nuts, and whole grains) that make a healthy diet according to the WHO Healthy Diet Fact Sheet (World Health Organization, 2020), and the second threshold is associated with the lowest risk of micronutrient adequacy ((Zhao et al., 2017)).

The exponential bootstrap method generates replication weights, allowing for the correction of standard errors associated with calculated outcomes, such as resilience scores. In each replication, positive non-integer weights are drawn from an exponential distribution and applied to all observations. These weights account for the original survey design by incorporating panel weights and clustering at the enumeration area and parent-household levels. This approach ensures a robust uncertainty estimation by capturing variability in model-derived outcomes rather than directly observed data. Bootstrap weights are used for all three steps of the estimation.

Our main hypothesis would imply that $\beta_6 > 0$. This means that in MM communities we expect the gender gap in resilience to food insecurity to be smaller than in non-MM communities. At the same time, droughts are expected to worsen households' food security. Therefore, the coefficient of the triple interaction, β_7, is expected to be positive if, when hit by a drought, households with female land managers in MM communities are more resilient than similar households in non-MM communities and negative if they are less resilient.

4. Results

4.1. Main results

The first five models specified in Annex A.3 and the preferred specification reported above (Eq. (1)) are estimated separately for each outcome and relative resilience scores, measured against two different thresholds for each indicator. The estimates of the first five models are reported in Tables B12 to B16, while the results of the fully interacted Model (1) are shown in Table 3. As expected, the RS measured against the lower thresholds are higher for both indicators. This is particularly true for the household diet diversity that, on average, shows a probability of 94% of being $HDDS > 5$. However, considering the national-specific food consumption score threshold ($FCS > 44$), the estimated average probability of having sufficient food consumption is only 42% in the whole sample. Resilience to loss in dietary diversity is generally higher than resilience to loss in terms of food consumption scores, which captures both access and nutritional quality of food consumed.

We analyze the key coefficients stepwise. The simplest specification (Model A3.1) shows that being hit by a drought, having a plot that is female-managed and living in a community that is prevalently Matrilineal-Matrilocal are all negatively associated with our outcomes (see Table B12). Obviously, such coefficients also capture the covariance between the outcomes and potential correlates of our three key independent variables, therefore being highly biased. Thus, as discussed in the empirical strategy section, we proceed stepwise by adding controls that might attenuate such a bias. As a first addition, we include the interaction between drought (D) and female land management (FLM) in the specification (Model A3.2). The three coefficients discussed earlier are qualitatively unchanged, and the coefficient of the interaction between D and FLM shows that, in case of drought, female-managed plots are more resilient than male-managed plots (see Table B13). When we add to Model A3.1 the interaction between D and N (Model A3.3), we find mixed results for N depending on the

[17] In the main analysis, households with joint land management are excluded from the sample. They will be reintroduced in the robustness checks.

[18] Households originated by the split of a previously observed household are clustered with their original household of reference, which we call "parent household".

Table 3
Estimation of Eq. (1).

Dependent variable:	(1)	(2)	(3)	(4)	(5)	(6)
	Food Consumption Score			Household Dietary Diversity Score		
	FCS	$RS : p(FCS > 35)$	$RS : p(FCS > 44)$	HDDS	$RS : p(HDDS > 5)$	$RS : p(HDDS > 7)$
Mean of dependent var.:	43.80	0.82	0.42	7.92	0.94	0.65
Drought	−11.138***	−0.275***	−0.497***	−2.590***	−0.134***	−0.476***
	(1.936)	(0.027)	(0.017)	(0.402)	(0.015)	(0.027)
Female Land Management	−3.200***	−0.103***	−0.135***	−0.501***	−0.036***	−0.109***
	(0.937)	(0.008)	(0.007)	(0.159)	(0.004)	(0.007)
Drought × Female LM	8.053***	0.195***	0.346***	0.892**	0.073***	0.218***
	(2.631)	(0.022)	(0.016)	(0.399)	(0.011)	(0.020)
Norm (1 = Matrilineal-Matrilocal)	14.797	1.935***	1.160***	1.155	0.712***	0.310**
	(24.943)	(0.196)	(0.142)	(2.375)	(0.118)	(0.136)
Drought × Norm	4.796	0.176***	0.121***	2.234***	0.152***	0.423***
	(3.099)	(0.032)	(0.022)	(0.569)	(0.017)	(0.033)
Female LM × Norm	0.360	0.037***	−0.016*	0.382	0.042***	0.098***
	(1.413)	(0.012)	(0.008)	(0.240)	(0.006)	(0.010)
Drought × Female LM × Norm	−5.791*	−0.202***	−0.195***	−1.374***	−0.129***	−0.379***
	(3.295)	(0.030)	(0.020)	(0.518)	(0.016)	(0.028)
N obs.	1688	1680	1680	1688	1685	1685
N. reps	500	500	500	500	500	500
R^2	0.271	0.810	0.952	0.343	0.740	0.925

Authors' calculation from Sample 5 (rural agricultural households observed at least in two consecutive rounds, joint land management excluded) from the Malawi IHS panel. Pooled OLS regression. The threshold used for each Resilience Score (RS) is specified in the parenthesis expressing the RS as the probability to be above the threshold. Drought is = 1 when SPEI-6 < −1.5. The base level for Female Land Management (1st land manager) is Male. Norm is = 0 for all communities where the prevalent marriage type is other than Matrilineal-Matrilocal steadily over time. Bootstrap standard errors in parentheses. Constant term, third-degree polynomial terms for the lagged outcome, and fixed effects for the year, consumption month, and grid are included in all models. To control for splits, dummy variables (= 1 if the household split) are included separately for each year. Bootstrap weights were calculated with exponential distribution based on survey design and household weights, clustering at EA level.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

chosen outcome (the other key coefficients are qualitatively stable) – see Table B14. While the kinship norm is associated with lower FCS and FCS-related resilience scores only when there is a drought, the MM norm is negatively correlated with HDDS and its resilience scores when there is not a drought. Still, it is associated with higher resilience when hit by the shock. This result reveals that the kinship norm may function differently under normal conditions than stress conditions. In addition, by introducing the interaction term, we account for a specific conditional relationship between drought and the kinship norm that was previously omitted. Without the interaction term, the model might have been mis-specified, attributing some effects of drought (or the absence thereof) incorrectly to the kinship norm.[19]

Moving forward, we add to the baseline specification the interaction between female land management and MM norm (Model A3.4) because the matrilineal-matrilocal norm might have different implications depending on the management structure of the plot. Similar to the previous specification, we obtain mixed results. In plots managed by men, the MM norm is negatively associated with FCS or HDDS (and their respective resilience scores). However, when the plot is managed by a woman, being in a community that is prevalently MM is associated with an even lower FCS, while in the case of HDDS (and its resilience scores) being in MM communities partly offsets the negative effect of female land management (see Table B15). Furthermore, we add the double interaction between our three key independent variables and their triple interaction (Model A3.5). Table B16 shows that MM kinship norm is associated with higher resilience when households are hit by drought, or their plots are managed by a woman (Table B16), although the results are statistically significant only for HDDS and its resilience scores.

Finally, when we account for potential structural differences between Matrilineal-Matrilocal societies and others (Model (1)) – and differently from the previous estimations, MM communities generally present higher resilience to food insecurity than non-MM communities and even more so in the case of drought (Table 3). The change in the sign of N between the specifications with and without the full interactions with N can have several possible explanations. For example, the interaction terms between the norm and all the covariates allow the model to capture conditional relationships that were previously hidden in the simpler models. In addition, the simpler model without interaction terms may suffer from omitted variable bias, where the coefficient of the kinship norm is confounded by its relationship with other covariates. Nevertheless, we cannot exclude that the change in the sign of the N coefficient is driven by multicollinearity due to the insertion of interaction terms between N and the other covariates. Hence, results on N must be interpreted with some caution.

The last sets of results confirm that female land management per se is associated with lower resilience scores. However, this negative relation is mitigated by the MM kinship norm in the specific case of HDDS, while for FCS this is the case only for the lower threshold ($FCS > 35$). As expected, drought per se increases food insecurity but female land management is significantly associated with a lower negative effect of droughts. Similarly, living in a MM community mitigates the negative effect of drought on resilience to food insecurity. However, the magnitude of this mitigating effect is lower than the mitigating effect of female land management.

However, the triple interaction between female land management, drought, and norm shows that, when experiencing a drought, households with female land management in MM communities are less resilient than similar households in non-MM communities in terms of both food consumption and dietary diversity. Indeed, the graphical representation of the distribution of resilience scores for different groups defined by the three variables in the interaction term (see Fig. 2 concerning dietary diversity[20]) shows that, while the gender gap in resilience between households with male and female land management

[19] Previous literature analyzed the cooperation role of different marriage arrangements in normal time (*e.g.*, Barr et al., 2019) and in periods of stress (*e.g.*, Dessy et al., 2024)

[20] The same applies, though less evidently, to the food consumption score.

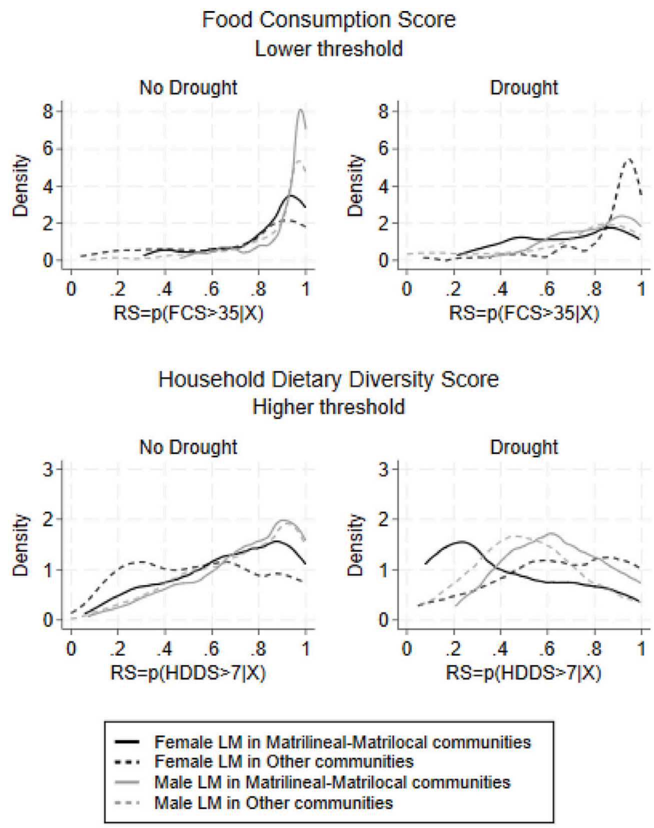

Fig. 2. Distribution of Resilience Scores by drought, land management (LM) and Norm. Kernel density plot. Resilience Scores (RS) from estimates in Table 3. X represents all independent variables included in Model (1) on which RS are conditioned.

(*i.e.*, the distance between the two solid lines) in normal times is lower in MM than in non-MM communities, in the case of drought most of the households with female land management in MM areas show higher density at lower resilience scores. In contrast, the distribution of resilience scores is skewed to the right (*i.e.*, towards higher resilience levels) for households with male land management.

All in all, our findings suggest that the MM kinship norm is associated with higher resilience to shocks and lower vulnerability in the case of notably disadvantaged conditions, like owning female-managed plots. Such results hold stable for the HDDS indicator and its related resilience scores, irrespective of the richness of the empirical specification (*e.g.*, with or without the interaction between the norm and all the controls).

To check for the consistency of resilience scores obtained with different food security indicators and against multiple thresholds, we examine whether they similarly order households. The Spearman rank correlation coefficients, presented in the above panel of Table B17, show that, overall, the different indexes and thresholds produce ranks that are quite well correlated (between 71% and 94%). As highlighted by Upton et al. (2022), when we compare different resilience measures, it is important to control if they identify the poorest group in a similar way. Therefore, Spearman's rank correlation is also measured on a set of dummies taking value 1 when the household is in the bottom 20% for each RS. The coefficients are smaller but still well above 50%. We can also see that the HDDS-based resilience measured against the highest threshold (HDDS = 7) produces a rank more similar to the FCS resilience score rank based on the highest threshold (FCS = 44) when we consider the overall ranking. However, suppose we focus on the correspondence of the bottom 20% in the different rankings. In that case, the former correlates more with the RS measured as the probability of being above the lower threshold for the FCS (FCS = 35).

Robustness checks

Several robustness checks are performed to test whether the correlation of our main variables of interest with RS changes when controlling for additional variables or modifying either the sample selection or the definition of our main variables.

Firstly, we replicate the analysis by adding a different set of controls (Figure B6). We initially control for demographic characteristics: household size, age of the household head, average education of adult members, demographic dependency ratio, and absence of adult males in the household. Then, we control for characteristics of the agricultural activities such as total cultivated land area, crop diversification, indicator for intercropping, and livestock owned. Furthermore, we account for potential structural differences in plot quality and technology adoption between male and female land managers. Previous studies have found that men usually manage larger plots with higher soil quality (Fafchamps & Quisumbing, 2002). Therefore, we add to agricultural controls also the share of sandy or loamy land and the share of land with moderate to high erosion rate. Then, we add to our base model controls for the household's relative wealth, the amount of remittances received in the previous 12 months, and participation in different social assistance programs. The last set of controls includes climate variables: a dummy for same-year floodings (measured as SPEI-6 > 1) and a dummy for drought in the year immediately before each survey round. All these control sets are then added to the main model.

Secondly, we control for possible interactions between the effect of the kinship norm and ethnicity by controlling in turn for: (i) households' ethnicity and (ii) the respondent's ethnicity to the community questionnaire. We also replicate the analysis after excluding households from villages that report a time-inconsistent norm. Then, we use a definition for the kinship norm based on Berge et al., 2014's districts classification. Results are shown in Figure B7.

The second and third round data also include information on the second manager of each plot. We built a three-category variable for the second land manager in a similar way as we did for the first land manager. As shown in Table B2, the gender of the first and second land managers is not the same in most cases. For about 63% of the households, the second decision-maker for all the plots is always a woman, meaning that, even in cases where men are the first manager, it is likely that the second decision-maker is a woman. Moreover, when the first land managers are only females, the second land managers are also women in 78.8% of the cases. Therefore, thirdly, we check for the robustness of the definition of the gender of the land manager (Figure B8) by: (i) controlling for the gender of the second land manager; replicating the analysis on the sample that includes households with joint land management (Sample 4) (ii) first with our main definition of land management and (iii) then with a definition that considers the gender of the first and second plot's manager together; (iv) replicating the analysis on the sample of households where the gender of the land manager corresponds to the gender of the household head.

Finally, we exclude households that moved from their original Enumeration Area and, therefore, might have relocated to villages with different norms (Figure B9). We also address potential confounders linked to split households by controlling for households that lost an income earner after splitting and replicating the analysis after excluding all households that ever split from the sample (Figure B10).

All these robustness checks are based on resilience scores estimated with Eq. (1) using the higher threshold for both indicators (*i.e.*, FCS = 44 and HDDS = 7) and either adding covariates to the model or adjusting the sample used in the analysis. Our main results are generally confirmed for both indicators. When we define the gender of the land manager according to both first and second plot managers, results for HDDS-based resilience are consistent. In contrast, the negative correlation between the triple interaction and FCS-based resilience scores becomes non-significant.

Furthermore, we emphasize that including agricultural and climate covariates reduces both the magnitude and significance of the Norm coefficient. A similar effect is observed when we exclude households from areas where the prevalent norm changes across survey rounds. These results suggest that the Norm variable captures additional spatially-defined characteristics beyond the direct interaction between the norm, drought, and land management. As a result, we conclude that (i) a causal interpretation of our results is not possible, and (ii) the positive correlation between Matrilineality-Matrilocality and food security is likely influenced by other contextual factors. Nevertheless, even after controlling for these covariates, the estimates of other coefficients remain consistent with our main findings. A more detailed explanation of all the robustness checks performed can be found in Annex A.5.

4.2. Mechanisms

While pro-men differences in resilience have been widely documented in the literature (*e.g.*, Kilic et al., 2015) it is less understood why, in case of drought, women are less resilient than men in MM communities with respect to non-MM communities. To explore possible mechanisms leading to this finding, we focus on the allocation of working time and changes in livestock holdings.[21] Summary statistics for the variables used in the analysis of mechanisms are presented in Table B21. Differences between households in MM vs non-MM villages (Table B22) suggest potential differences in how protective factors or coping mechanisms may work in different contexts.

Reallocation of working activities.

Labor markets can be used to diversify income both to reduce weather risk *ex-ante* and as a coping strategy *ex-post* (Rose, 2001). Adverse rainfall shocks are associated with a higher supply of off-farm labor, especially in the non-agricultural sector (Ito & Kurosaki, 2009), which, in turn, has a positive effect on food security (Owusu et al., 2011).

The individual roster of the Malawi IHS provides information on the number of hours spent by each household member who is more than 5 years old on different activities during the week before the interview, namely: (i) households' agricultural activities; (ii) households' non-agricultural business; (iii) wage, salary, and in-kind work; (iv) casual, part-time or *ganyu*[22] labor. We aggregate this information at the household level and calculate the amount of time per capita spent in each activity.[23]

To check whether the interaction between the kinship norm, the gender of the land manager, and the exposure to drought is significantly associated with a household's work-time allocation, we use a fixed-effect estimator. Our dependent variable is the households' average per capita work hours spent on each type of activity. We use year, consumption month, and household fixed effects, ad we control for split households. In addition, we control for the percentage of time spent on each activity by the household's women. Then, we repeat the estimate by also controlling for the demographic characteristics of the household (including the departure of a household member who was an income earner in the previous round), agricultural characteristics, and social safety nets.

Table 4 shows that, while in case of drought, households with female land management generally tend to work more in non-agricultural businesses, in MM communities, households with female land management tend to allocate more time to households' agricultural activities when hit by drought. Therefore, there is a different mechanism of working time reallocation in case of drought between MM and non-MM communities.

Livestock. Livestock can work as a buffer stock, allowing households to smooth consumption in bad times (Bromley & Chavas, 1989). Fafchamps et al. (1998) test this hypothesis for farmers in Burkina Faso and find that, despite having a limited ability to smooth income in case of drought, fluctuations in livestock holdings are more common for small stock compared to cattle because of the former's lower lumpiness and higher liquidability. Kazianga and Udry (2006) find minimal consumption smoothing (predominantly among the rich) and no buffer capacity of livestock in the same context.

We have already shown that our main results are stable when we control for livestock owned (Figure B6). To test whether in case of a drought shock livestock holding dynamics differ between households with male or female land management in MM vs. non-MM communities, we use a fixed effect estimator to regress our main variables of interest and their interaction on: livestock holdings measured in Tropical Livestock Units (TLU)[24]; and the current value of livestock (in MK).[25]

Table 5 shows that female land management in MM communities is negatively correlated with current livestock in case of drought. From descriptive statistics (Table B21), we see that there has been a decrease in the total amount of livestock owned by households between 2013 and 2016. We lean towards the argument that the observed decline in livestock figures was primarily caused by animal deaths, rather than their sale for consumption smoothing. Indeed, the severe drought that occurred in 2015–16 was documented as being devastating for livestock (World Bank Group et al., 2016). Livestock figures are, on average, lower in MM areas (Table B22), and the finding that female land management in MM communities is correlated with less livestock during droughts could be related to a lower capacity of this group

[21] We also explored access to credit and extension services as well as remittances received as potential mechanisms. However, they do not turn out to be significant. Furthermore, we also checked for crop diversification and using modern inputs (*i.e.*, fertilizers and pesticides) as other possible mechanisms. The results show that, while households with female land management show less diversified plots in normal times, they show a relatively higher diversification in case of drought. However, while female land management is associated with higher diversification in MM communities relative to similar households in non-MM communities, in the case of drought, we observe a negative association between crop diversification and households with female land management in MM villages, which is consistent with our main results. We also find that households with female land management in MM areas are associated with lower fertilizer use in times of drought than those in non-MM villages. However, even though partial adaptation of crop mix is possible during the agricultural season and farmers can decide whether to apply more fertilizer/pesticides during a drought, we cannot rule out that such a decision was made independently from the drought shock as it happens at the beginning of the rainy season. Therefore, we prefer not to include these two transmission channels in our discussion about potential mechanisms. We thank one of the anonymous reviewers for pointing out this issue.

[22] *Ganyu* labor is defined as "any off-own-farm work done by rural people on a casual basis" (Whiteside, 2000: p.1) and it is considered both an *ex-post* coping strategy and an *ex-ante* mechanism to mitigate risks (Dimowa et al., 2010).

[23] We calculate the per capita amount of time t spent on activity a for a household composed by n individuals older than 5 years of age as $\sum_{i=1}^{n} t_{ai}/n$. In this way, we indirectly control for household size and potential complementarity of different activities, which would not be captured if using the total amount of hours spent on each activity by all household members.

[24] We use the following TLU conversion factors specific for Sub-Saharan Africa (Njuki et al., 2011): 0.5 for cattle (large ruminants), 0.2 for pigs, 0.1 for sheep and goats (small ruminants), 0.8 for horses, 0.03 for ducks, 0.02 for rabbits, 0.01 for chickens.

[25] The MIHPS asks households to estimate how much they would receive if they sold one of each type of animal they own at the moment of the interview. This value is then multiplied by the number of animals of each type owned and aggregated at the household level. Monetary values are deflated with the World Bank CPI. In the estimation, we use a logarithmic transformation of the livestock value.

Table 4
Mechanism: allocation of per capita work time.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Households' average of hours worked per capita per week in:							
	Household's agricultural activity		Household's business (non-agriculture)		Wage, salary, or in-kind work		Casual, part-time, and ganyu labor	
Drought	0.610	0.361	−0.130	−0.039	0.049	0.046	−0.204	−0.141
	(1.509)	(1.453)	(0.422)	(0.433)	(0.498)	(0.490)	(0.385)	(0.387)
Female Land Management	−0.955*	−0.635	−0.153	−0.129	0.383	0.393	−0.080	0.089
	(0.497)	(0.576)	(0.314)	(0.264)	(0.402)	(0.364)	(0.379)	(0.410)
Drought × Female LM	−0.667	−1.129	0.938**	0.891*	0.156	0.229	0.052	0.064
	(1.172)	(0.920)	(0.460)	(0.515)	(0.506)	(0.508)	(0.745)	(0.695)
Women's work (perc.)	0.053***	0.054***	0.049***	0.048***	0.048***	0.046***	0.039***	0.039***
	(0.007)	(0.007)	(0.009)	(0.009)	(0.009)	(0.009)	(0.006)	(0.006)
Drought × Norm	0.102	−0.146	−0.191	−0.454	0.219	0.343	2.417	2.240*
	(1.917)	(1.785)	(0.646)	(0.686)	(0.859)	(0.914)	(1.552)	(1.130)
Female LM × Norm	−0.649	−0.737	−0.355	−0.370	−0.370	−0.426	−0.122	−0.495
	(0.952)	(0.964)	(0.787)	(0.692)	(0.519)	(0.492)	(0.498)	(0.566)
Drought × Female LM × Norm	2.365*	3.166**	−0.916	−0.871	−1.031	−1.094	−0.992	−0.667
	(1.329)	(1.204)	(0.777)	(0.827)	(0.874)	(0.869)	(1.357)	(1.175)
Women's work (perc.) × Norm	0.001	−0.003	0.023	0.025	0.053	0.051	−0.006	−0.009
	(0.009)	(0.008)	(0.018)	(0.018)	(0.035)	(0.033)	(0.008)	(0.008)
Demographic controls[a]		YES		YES		YES		YES
Agricultural controls[b]		YES		YES		YES		YES
Safety net controls[c]		YES		YES		YES		YES
N obs.	2758	2741	2758	2741	2758	2741	2758	2741
N. groups	1070	1069	1070	1069	1070	1069	1070	1069
R^2	0.17	0.22	0.21	0.22	0.09	0.11	0.15	0.17
σ_u	12.42	10.80	10.82	9.96	4.35	6.27	11.63	11.30
σ_e	6.55	6.39	3.56	3.59	3.04	3.05	3.54	3.52
ρ	0.78	0.74	0.90	0.89	0.67	0.81	0.92	0.91

Authors' calculation from Sample 5 from the Malawi IHS panel. Fixed effects estimator. All models include: constant term; fixed effects for the year, consumption month, and household; dummy variables for split households. Standard errors, in parentheses, clustered at the EA level.

[a] Demographic controls are household size, age of the household head, average education of adults, dependency ratio, dummy for the absence of adult males; and indicator for the loss of an income earner if the household split.

[b] Agricultural controls include land area, crop diversification index, livestock holdings (in TLU), and dummy for intercropping.

[c] Social safety nets include dummies for participation in aid programs, also controlling for a wealth index.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

to handle weather shocks. This could be another possible mechanism leading to our main result. However, the significant correlation with livestock holdings in terms of TLU is not reflected in similar correlation with respect to livestock value.

5. Concluding remarks

This study investigates the interplay between gender, kinship norms, and the effects of droughts on agricultural households' resilience to food insecurity in Malawi. Our analysis provides additional evidence that, in agrarian settings, households' food security is linked to women's role in agricultural production (Doss et al., 2014; Njuki et al., 2016) and that household resilience to climate-induced food insecurity is not gender-neutral (McKune et al., 2015; Ramachandran, 2013). Moreover, we provide new evidence that cultural and social norms are associated with different patterns in food security (Briones Alonso et al., 2018) and resilience (Béné et al., 2016; Chisty et al., 2021; Phuong et al., 2023; Weichselgartner & Kelman, 2015). In particular, we show the pivotal role of the combination of inheritance and post-marital residence norms in shaping gender-specific food security resilience levels and their changes in response to weather shocks.

We empirically tested how resilience to food insecurity is related to the interaction of three conditions, namely: (i) different land management (female vs. male), (ii) the prevalent kinship norm in a community, *i.e.* Matrilineal-Matrilocal (MM) vs. any other, and (iii) experiencing or not a drought. We find that in MM communities, households' resilience to food insecurity and to loss of dietary diversity in particular is higher than in non-MM communities during droughts. Moreover, gender differences in land management also play a role, with female land management being generally associated with lower resilience scores. However, this negative relation is partially compensated by the kinship norm in MM communities in the Household Dietary Diversity Score, while in the case of Food Consumption Score we obtained mixed results. Interestingly, when experiencing a drought, households with female land management in MM communities are less resilient than similar households in other communities.

Exploring potential mechanisms explaining our main results, we find suggestive evidence that the lower resilience to food insecurity in times of drought of households with female land management in MM communities, with respect to similar households in non-MM communities, is potentially due to a lower engagement in more remunerative activities (such as non-agricultural business), and a lower use of agricultural inputs (*i.e.*, fertilizer). Households with female land management in MM communities might also have faced higher livestock losses due to the drought shock. However, we cannot thoroughly test this hypothesis because of data limitations.

We conclude that, while kinship norms in favor of women generate a relatively protective and enabling environment for female farmers in MM communities, which translates into higher resilience to food insecurity for their households relative to similar ones in non-MM villages, other types of gender gaps (*i.e.* non-farm employment, and ownership and maintenance of livestock) and trade-offs in the choices regarding agricultural production (*i.e.* use of fertilizers) may offset this relative advantage in times of drought.

Empowering female farmers, improving their access to key agricultural inputs, and increasing women's adoption of weather-resilient agroecological practices are crucial steps in building resilience to food

Table 5
Mechanism: livestock holdings.

	(1)	(2)	(3)	(4)	(5)	(6)
	Livestock (TLU)			Log Livestock value (MK)		
Drought	0.017	0.012	0.063	0.453	0.354	0.354
	(0.067)	(0.058)	(0.165)	(0.319)	(0.303)	(0.303)
Female Land Management	0.021	0.074	0.222	0.002	0.026	0.026
	(0.077)	(0.062)	(0.196)	(0.397)	(0.395)	(0.395)
Drought × Female LM	0.125	0.068	0.157	−0.293	−0.479	−0.479
	(0.099)	(0.077)	(0.177)	(0.429)	(0.502)	(0.502)
Livestock slaughtered (TLU)		2.404**	1.435		3.077**	3.077**
		(0.991)	(1.552)		(1.382)	(1.382)
Livestock bought (TLU)		0.895***	0.762**		3.515***	3.515***
		(0.233)	(0.343)		(0.622)	(0.622)
Drought × Norm	0.008	0.023	−0.058	−0.747	−0.213	−0.213
	(0.089)	(0.081)	(0.223)	(0.511)	(0.510)	(0.510)
Female LM × Norm	−0.004	−0.001	0.055	−0.129	0.198	0.198
	(0.092)	(0.087)	(0.255)	(0.607)	(0.597)	(0.597)
Drought × Female LM × Norm	−0.226*	−0.194**	−0.525**	0.640	0.615	0.615
	(0.115)	(0.097)	(0.262)	(0.543)	(0.611)	(0.611)
Livestock slaughtered (TLU) × Norm		−2.462**	−1.515		−6.250	−6.250
		(1.184)	(1.861)		(4.894)	(4.894)
Livestock bought (TLU) × Norm		−0.109	0.652		−0.268	−0.268
		(0.283)	(0.406)		(1.056)	(1.056)
Conditional on owning livestock			Yes	Yes	Yes	Yes
N obs.	1892	1892	956	956	956	956
N. groups	1068	1068	694	694	694	694
R^2	0.08	0.15	0.16	0.20	0.29	0.29
σ_u	0.82	0.89	1.03	2.71	2.86	2.86
σ_e	0.51	0.50	0.79	1.26	1.22	1.22
ρ	0.72	0.76	0.63	0.82	0.85	0.85

Authors' calculation from Sample 5 from the Malawi IHS panel, years 2013 and 2016. Fixed effects estimator. All models include: constant term; fixed effects for the year, consumption month, and household; dummy variables for split households; demographic controls (household size, head's age, average adults' education, dependency ratio, absence of adult males, loss of income earner); agricultural controls (log of land area, crop diversification, intercropping); social safety nets (wealth index and dummies for participation in aid programs). In columns 2, 3, 5 and 6, we also control for the livestock (TLU): sold alive; lost or stolen; and given away for free (all coefficients not significant). All covariates interact with Norm. Standard errors in parentheses, clustered at the EA level.

* $p < 0.10$.

** $p < 0.05$.

*** $p < 0.01$.

insecurity. In addition, fostering women's access to off-farm employment opportunities would allow households to use income diversification as a strategy to enhance their resilience to weather shocks. However, such efforts might be ineffective if these policy interventions do not adequately account for the interplay between gender and cultural norms and, even further, their combination with the effects of weather shocks. Therefore, further investigation is needed to disentangle the combined impact of gender differences, cultural norms, and exposure to weather shocks on agricultural production choices and their consequences on household welfare.

Moreover, our analysis focuses on household-level food security resilience, looking at gender differences within the household related only to land management. However, cultural norms also affect intra-household allocation of resources (Aminjonov et al., 2023), and kinship norms in Malawi could potentially shape different individual levels of food security for female and male household members. Therefore, future research should focus on individual-level food security outcomes to disentangle possible intra-household gender differences.

Finally, our work raises the question of how to deal with the mutable nature of customary norms, too often treated as fixed social norms. As highlighted by the anthropological literature, traditional norms regulating inheritance and post-marital residence are not given once and forever, and they are influenced by the changing context (Holden et al., 2003; Shenk et al., 2019). Previous works that investigated the effects of kinship norms in Malawi on agricultural production and household welfare (Asfaw & Maggio, 2018; Lovo, 2016) either used the community self-reported prevalent norm of the LSMS-ISA but employed only one round of data (*i.e.*, Lovo, 2016) or relied on the classification of districts based on the prevalent norm and ethnic groups according to the 2007 census (Berge et al., 2014). This static picture of kinship norms does not seem to capture the dynamics emerging from Malawian data accurately. Therefore, we tried to account for this temporal heterogeneity by defining as Matrilineal-Matrilocal only those villages reported as such in all survey rounds, performing at the same time several robustness checks to control for potential biases hidden in our choice. However, we are aware of the theoretical and empirical challenges potentially posed by this choice, and we suggest further investigation of the causes and consequences of transitions from customary norms of inheritance and post-marital residence as an important avenue for future research.

CRediT authorship contribution statement

Immacolata Ranucci: Writing – original draft, Methodology, Formal analysis, Data curation, Conceptualization. **Donato Romano:** Writing – review & editing, Methodology, Conceptualization. **Luca Tiberti:** Writing – review & editing, Methodology, Conceptualization.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix A. Supplementary data

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.worlddev.2024.106847.

Data availability

The replication package for the analysis presented in this paper is publicly available on GitHub. It includes all necessary code, data, and documentation to reproduce the main results. You can access the replication package at the following link: https://github.com/ImmaRanucci/Resilience_foodsecurity_norms_Malawi. Users are welcome to download, use, and share the materials provided, under the condition of appropriately citing this paper.

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