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Gendered effects of climate and conflict shocks on food security in Sudan and the mitigating role of social protection

Aysegül Kayaoglu[1], Ghassan Baliki[2], and Tilman Brück[3]

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Abstract
Climate change and violent conflict are defining challenges of our time. However, it is not yet understood how they interact in shaping human welfare and food security, how their interaction shapes gendered outcomes, or how social protection systems can mitigate their impact. To address these knowledge gaps, we first examine how household food insecurity relates to conflict and climate shocks and whether these associations are gender-sensitive. Second, we test what mechanisms can reduce the negative impacts of these shocks. Our empirical analysis relies on novel survey data of 7,908 rural households collected across 14 states in Sudan in 2022. Sudan currently faces floods, droughts, and violent conflict affecting agricultural production and food supply. We find that climate shocks do not significantly affect food consumption scores (FCS), while exposure to violent conflict leads to a substantial decrease in FCS. Both productive and non-productive assets increase FCS for all households, especially female-headed households. Longer distances to agricultural input and output markets correlate with lower FCS, particularly for male-headed households. Women's social group membership positively impacts on FCS for female-headed households. However, women do not receive additional benefits from other social networks during climate and conflict exposure, while male-headed households benefit from all types of social networks. Income diversification is identified as a key strategy for improving FCS, particularly for female-headed households during conflict. Informal cash transfers significantly improve FCS, especially for female-headed households. In contrast, formal cash transfers negatively correlate with FCS, although they positively impact on male-headed

[1] ISDC - International Security and Development Center, Berlin and University of Bremen, Germany, corresponding author: kayaoglu@isdc.org
[2] ISDC and Humboldt University of Berlin, Germany
[3] ISDC, Humboldt University of Berlin, and Leibniz Institute of Vegetable and Ornamental Crops, Großbeeren, Germany

households during violent conflict. Overall, we recommend targeted social protection programmes that address gender disparities and enhance resilience among vulnerable populations.

Keywords
gender, climate change, conflict, food security, social protection, Sudan

JEL Classifications
I31, J16, Q12, Q18

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1 Introduction

Conflict and climate change are the two most pressing global challenges that disrupt societies and economies and put lives and livelihoods at high risk (Stojetz et al. 2024; Verwimp et al. 2019). Both violent conflict and severe climatic events are concentrated disproportionately in low-income countries, where there is no access to effective institutions and systems to respond to their compounding effects. Understanding the impacts of climate and conflict shocks and finding ways to respond to them is crucial for developing effective social protection programming and systems to mitigate their adverse effects, particularly on vulnerable households. However, it is not yet understood if and how climate and conflict shocks combine to affect the welfare of households and how families cope with such negative duality. To address this gap, our paper aims to answer three fundamental questions. First, does exposure to both conflict and climatic shocks lead to worsening levels of food insecurity? Second, are the effects gendered? Third, what are the household-level mechanisms that can mitigate or absorb the separate and joint negative effects of these shocks?

To contribute to the literature about the gendered impacts of shocks, we analyse novel survey data from 8,146 rural households across 14 states in Sudan, collected in November 2022. In addition, we contribute to the literature by showing how the multiplicative nature of conflicts (i.e. polycrisis) is associated with households' food security and whether the gender of household heads plays a key role. Moreover, empirical analyses of gender-sensitive mechanisms that are crucial to reducing the negative impacts of conflicts are scarce, even though such analyses are essential to design effective policies and programmes to fight food insecurity in conflict-affected populations. Thus, we contribute to the literature by analysing the mechanisms that help mitigate the adverse effects of shocks on female- and male-headed households' food security.

2 Literature review

2.1 Polycrisis and food insecurity

Addressing food insecurity is crucial to improve human welfare and economic development. It has a complex nature, and its primary sources include conflict, environmental shocks, and inadequate infrastructure. The literature examining the association between food insecurity and conflict reveals the endogenous nature of this relationship (Brück and d'Errico 2019; Martin-Shields and Stojetz 2019). While armed conflict results in increased food insecurity due to disruptions to food production, distribution, and access (Baliki et al. 2018; Brück et al. 2019), food insecurity is also found to result in armed conflict within neighbouring societies, primarily due to intensified competition over food production resources such as land and water (Vesco et al. 2024). Farmer-herder conflicts in drought-affected communities are examples of this (Nnaji et al. 2022). However, in addition to food insecurity-related conflicts, we also observe armed conflicts that are not directly related to food insecurity, such as that experienced in Sudan after 2023. Food insecurity is more severe in cases of protracted conflict. For example, at the end of 2023, around 55% of the Syrian population was food insecure (WFP 2024a), while the share in Yemen was 52% (WFP 2024b). A growing body of literature studies the association between armed conflict and food insecurity in the short and long run and its gendered effects (Ronzani et al. 2024). For example, Weldegiargis et al. (2023) show high levels of conflict-induced food insecurity and household hunger in Tigray, Ethiopia. George et al. (2019) provide evidence about how Boko Haram's attacks

caused food insecurity in Nigeria. In line with these findings in other settings, we hypothesize a negative effect of conflict exposure on food security in our empirical analysis.

In addition to armed conflicts, the findings in the literature also show an association between food insecurity and climate shocks (such as floods, droughts, and other extreme weather conditions), focusing on the vulnerability of agricultural systems to extreme weather events. Dasgupta and Robinson (2022) present a significant correlation between severe food insecurity and climatic variations, analysing the United Nations Food and Agriculture Organization's (FAO) food insecurity scale in 83 countries from 2014 to 2019. A cross-country analysis by Niles and Salerno (2018) provides evidence for a 1.73-fold increase in the likelihood of food insecurity among households who report having experienced a climatic shock. They also find a significant association between poverty and food insecurity. There are different channels for the effect of climate shocks on food insecurity. The first mechanism is related to the decrease in food production due to reduced crop yields and livestock productivity. The second channel is through social stratification in economic production. Vulnerable populations are already more involved in rainfed agriculture in subsistence farming, and they have limited adaptive capacity. Therefore, climate shocks disproportionately increase the food insecurity of particular sociodemographic groups more than others. Further, in countries or regions with high levels of food insecurity, increased competition over scarce resources can create violent conflict, doubling the burden on households that already have high levels of food insecurity, and this complex relationship between climate shocks, violent conflict, and food insecurity can result in a vicious cycle (Shemyakina 2022). Lastly, climate shocks increase food prices and market volatility, contributing to food insecurity (Mavodyo 2023).

As violent conflicts and climate shocks are two essential drivers of food insecurity, addressing food insecurity requires us to consider polycrisis situations as well as other socio-economic dimensions. Identifying the channels through which the impact of these two heavy shocks will be diminished is therefore crucial to improving the welfare of crisis-affected households.

2.2 Food insecurity of female-headed households in polycrisis

Existing gender disparities in access to resources, coping strategies, and asset ownership may cause a more substantial increase in food insecurity levels due to conflict and climate shocks among female-headed households. While more studies focus on the gender dynamics of food insecurity within households, the literature contains only a few papers that address the gender sensitivity of food insecurity's relationship with violent conflict and climate shocks (Ronzani et al. 2024). Among these few, Riley and Ceaser (2018) show a significant association between gender inequality and food insecurity by comparing urban food security in Nanjing, China and Maputo, Mozambique. A substantial source of higher levels of food insecurity for female-headed households is the precarious employment or lower levels of employment of women in urban areas. Even fewer studies have analysed the channels that decrease the food insecurity of female-headed households in rural areas. For example, Mwai et al. (2023) highlight that female-headed households in Kenya are disproportionately affected by food insecurity induced by climate shocks due to their lack of access to land, credit, and agricultural inputs. Onyenekwe et al. (2022) also show that shock-induced food insecurity is higher among women-headed households due to their lower adaptive capacities.

2.3 Mechanisms of social protection

That said, the literature helps us identify essential mechanisms to decrease the food insecurity levels of female-headed households. These mechanisms are all linked to social protection, as they are mainly related to empowerment, capacity-building, and household resilience.

Cash transfers (both informal and formal) can increase the resilience of families, particularly female-headed households that are more likely to be resource poor. In the case of Sudan, remittances (i.e. informal cash transfers) act as an essential source of income for rural female-headed households, and analysing their association with food security can help us to predict the potential impacts of a cash transfer programme on food-insecure households. Declining rainfall, frequent drought, armed conflicts, and worsening natural resource degradation cause high migration rates from rural to urban areas in Sudan due to increasing levels of hunger and food insecurity (Depoortere et al. 2004; Eltigani 1995; Ibnouf 2011). An essential dimension of these migration flows is gender: it is predominantly men who migrate (Goldsmith et al. 2004; Jentsch 2006). Such migrant men may send (ir)regular remittances back to households headed by their wives, or alternatively it might be a younger male from the household who migrates and sends remittances back home. In the former case, not only household management but also agricultural production needs to be pursued by the female household heads. Therefore, agricultural production and patterns, as well as household food security, can be affected by these gendered migration flows in Sudan (Ibnouf 2011). Households can also benefit from formal cash transfers from non-governmental organizations (NGOs) or government institutions as income sources. This additional income can be used for the purpose of buying food and can therefore increase food consumption in recipient households, which might be particularly beneficial during crisis periods because other income sources might be endangered by conflict and climate shocks.

A second channel concerns women's lower access to services, which affects their households' food production and security. Female-headed households have much lower access to credit facilities, agricultural extension services, input markets, and basic services (Asmamaw et al. 2019; Aweke et al. 2020; Gebre et al. 2019).

Thirdly, improving social networks by incentivizing membership of associations and communities can help households build adaptive capacities and coping strategies during violent conflicts and climate shocks. Therefore, social protection programmes can increase the resiliency of households by facilitating community engagement (Ahmed et al. 2023; Cruwys et al. 2022; Khan 2023; Naveed et al. 2023).

The fourth vital channel to decrease food insecurity is increasing household asset ownership, as conflict-driven food insecurity is materialized mainly through agricultural input and income shocks (Baliki et al. 2024; George et al. 2019). Analysing the case of 31 sub-Saharan African countries, Ndjobo (2023) shows that lower levels of asset ownership among women are an important driver for their higher levels of food insecurity. Thus, any social protection programme that includes the provision of assets (productive or non-productive) to households will be more effective in fighting for food security (Weiffen et al. 2022).

Finally, income diversification can play a mitigating role for the adverse effects of shocks, particularly for smallholder farmers and rural households, as higher levels of diversification can act as an insurance and consumption-smoothing mechanism when key income sources are negatively affected by shocks.

3 Context

A large share of Sudan's population is rural, and relatedly, its economy relies mainly on rainfed agriculture. Moreover, a substantial proportion of the rural population depend on subsistence farming for their livelihood. Nonetheless, recent countrywide statistics show that 85.4% of the population do not have access to a healthy diet, while the prevalence of moderate or severe food insecurity is 51.8% (FAO et al. 2023). Therefore, it is essential to understand how different shocks affect food security and what mechanisms can help mitigate these adverse effects.

The agricultural sector in Sudan currently faces a crucial challenge due to the violent conflict that started in the country in April 2023, which turned into a severe humanitarian crisis in a short period. Conflict destroys agricultural infrastructure and decreases short- and long-term food supplies, increasing households' vulnerability to shocks (Brück et al. 2019). Furthermore, there are significant other multiplicative and recurring challenges in agricultural production and food supply due to high rainfall variability, pest and disease outbreaks, agricultural input unavailability and inaccessibility, and irrigation difficulties (FAO 2023). Production of the two primary basic crops, sorghum and millet, dropped by 28% and 44% respectively in 2021 compared with the previous five-year average (FAO 2023). For example, rainfall variability combined with intercommunal conflict had a significant and negative influence on millet production in North Darfur State, where production was estimated to be 75% lower than the previous five-year average. Flooding caused by excessive rainfall further harmed agricultural production and infrastructure, mostly in Sudan's southern states. Moreover, insufficient harvests created a food shortage, making the country more dependent on food imports. The reliance on food imports has further exacerbated food insecurity, especially since international wheat prices are soaring due to the Russia-Ukraine war (FAO 2023). The Integrated Food Security Phase Classification (IPC) assessment conducted from April 2021 to February 2022 showed that approximately 16% of the population was classified under the 'crisis' or 'emergency' phase of food insecurity (FAO 2023). These figures were particularly high in conflict-affected regions of North and West Darfur, where the proportions of the population under threat of acute hunger were 22% and 32% respectively (IPC 2023), and they may have been higher in 2023 and 2024 following the start of the conflict.

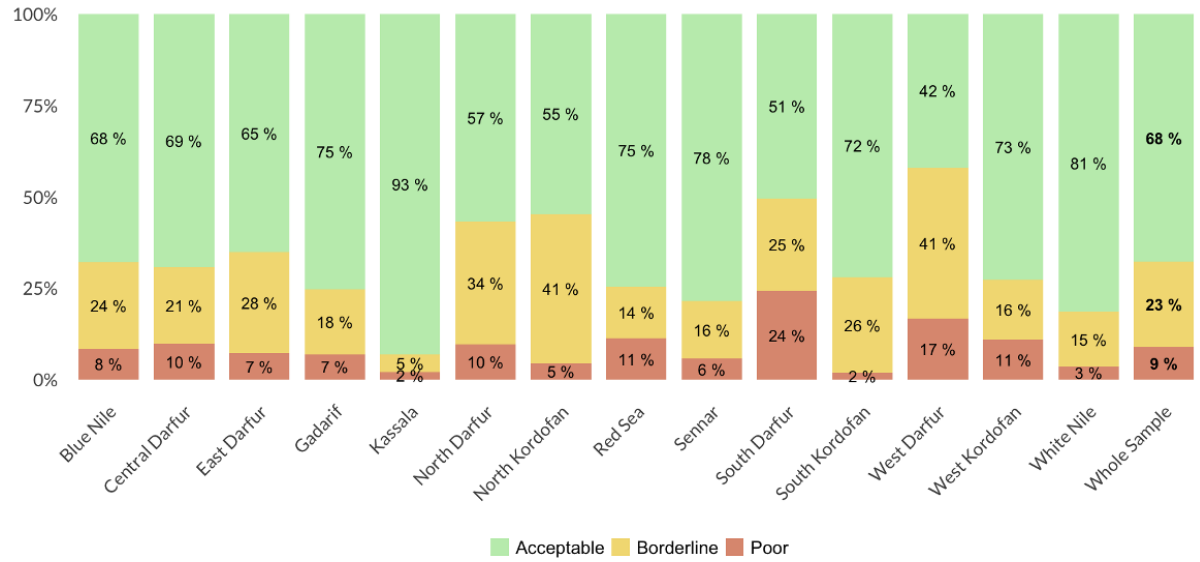
Thus, it is important to understand households' vulnerability to shocks, particularly conflict and climate change, so that their adaptive capacities in the face of these shocks can be progressively improved. Moreover, 'the gender-differentiated impact of climate and conflict crises and the subsequent additional burden many women must take on to sustain their livelihoods also tends to be invisible in national economic analyses and the formulation and implementation of development policies' (Ibnouf 2011: 216). This neglect is partly related to the scarcity of research in this area.

4 Data, variables, and methods

We use primary household survey data to test our hypothesis. The survey instrument and sampling were designed to evaluate the impact of agricultural and livestock aid provided by the FAO. A village-level pure randomization was used in 14 states of Sudan. FAO Sudan's local team organized the data collection, while we trained the enumerators. Data collection took place in November 2022. A total of 8,146 rural households were interviewed in 353 villages in the baseline data used in this paper's empirical analysis.[1] Thus, this is an important data source presenting the socio-economic conditions in rural areas just before the onset of the recent violence in April 2023.

Our survey has important information about the socio-economic characteristics of households and their agricultural production, income sources, access to services, and food consumption, among other relevant sections. In the empirical analysis, our dependent variable is the food consumption score (FCS) of households. The FCS indicates the frequency of household consumption of different food categories. It therefore reflects dietary diversity, food frequency, and relative nutritional importance. Households were asked how many days they had eaten food from a specific group in the previous seven days. The following categories were included, with the corresponding weights in parentheses: starches (two), pulses (three), vegetables (one), fruit (one), meat/fish/eggs (four), milk/dairy (four), fats (0.5), sugar (0.5), and condiments (zero). The FCS is derived from the sum of the weighted category values. The score takes a value between zero and 112 and is classified into 'poor' (0–21), 'borderline' (21.5–35), and 'acceptable' (>35) food consumption. Figure 1 presents the food insecurity of the sample across states in our data, measured by FCS. As can be seen, there are significant differences in the average FCS in rural areas. The largest shares of food-insecure households live in South Darfur, West Darfur, North Darfur, and North Kordofan. In contrast, the lowest levels of food insecurity are observed in Kassala and White Nile.

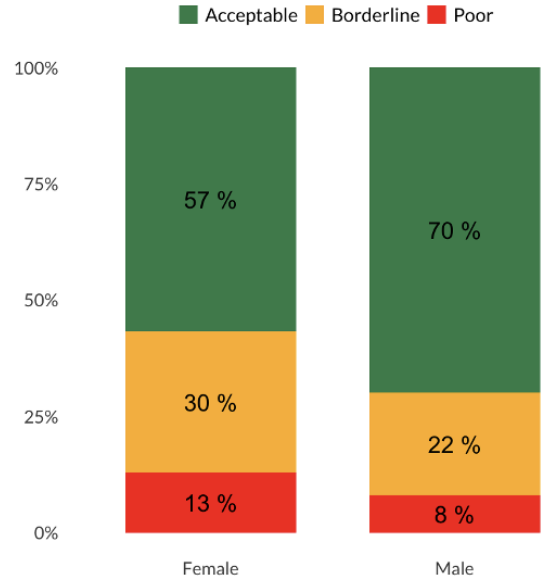
Figure 1: Food insecurity distribution across states



Source: authors' illustration.

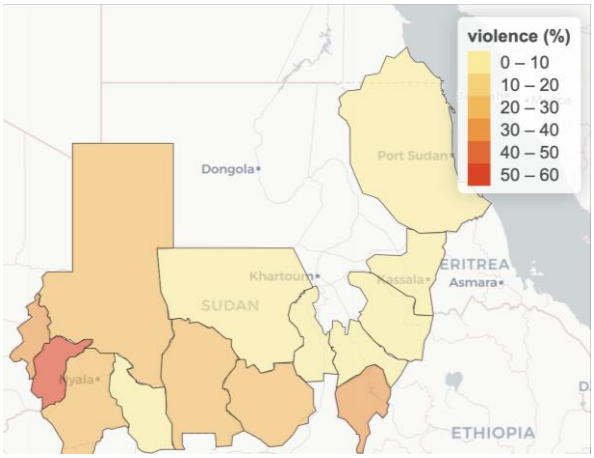
[1] In the full empirical model, 7,908 households are included in the analysis due to missing variables.

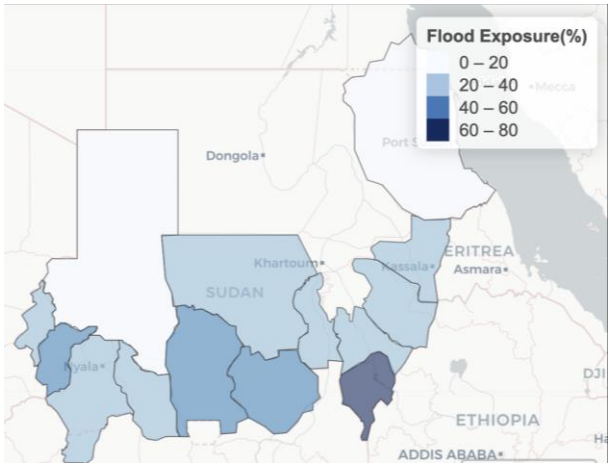
Figure 2: FCS by gender of household head

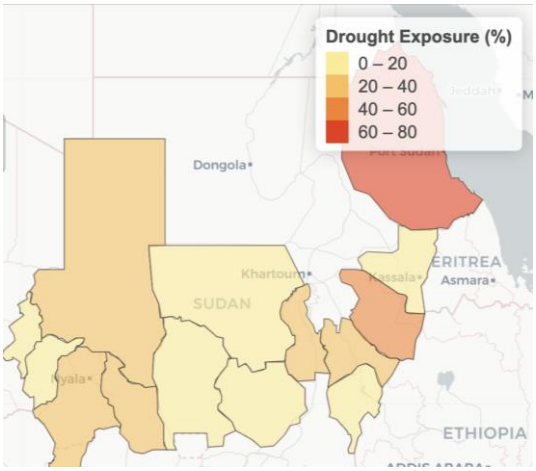


Source: authors' illustration.

Figure 3: Exposure to violence and climate shocks







Source: authors' illustration. This map was created using R. GIS shapefiles were downloaded from Humdata at: https://data.humdata.org/dataset/cod-ab-sdn.

In addition to the variation in FCS across states, we also observe significant differences by gender of household head. As shown in Figure 2, 43% of female-headed households have either borderline or poor FCS, while this is the case for only 30% of male-headed households. In the empirical analysis, we test whether female-headed households are still disadvantaged regarding food insecurity when we control for various individual factors and state-level fixed effects.

In addition to food consumption information, our survey instrument also had questions about household shock exposure. As our focus was to understand the short-term impact of shock exposure, we asked respondents about their exposure to various shocks in the three months previous to the date of the survey. Figure 3 presents the spatial distribution of households' exposure to violent conflict and extreme weather events across the 14 states in our data. As we can observe, the intensity of exposure to these shocks is felt at different levels in different states. While violence exposure is higher in Darfur regions, drought exposure is more substantial in Red Sea, and flood exposure is more significant in southern states.

Our main hypothesis concerns the (combined) impact of conflict exposure and climate shocks on household food insecurity. As climate shocks are experienced as either floods or droughts in different states, we generate a climate shock exposure variable equal to one if households reported having experienced flood or drought in the previous three months, and zero otherwise. We first test the regression equation (1):

$$FCS_{ijs} = \beta_0 + \beta_1 conflict_{ijs} + \beta_2 climate_{ijs} + \beta_3 conflict_{ijs} \times climate_{ijs} + X'_{ijs}\delta + \lambda_s + \epsilon_{ijs} \quad (1)$$

where FCS_{ijs} is the FCS of household i in village j and state s. Key explanatory variables are exposure to violent conflict and climate shocks (drought and flood). X'_{ijs} is the household-level control variables (age, gender, and education level of household heads), and λ_s is state-level fixed effects to control for any time-invariant state-specific factors affecting households' food insecurity. Standard errors are clustered at the village level as households' FCSs are expected to be related.

In addition to testing the association between shock exposure and food insecurity, we also test five mechanisms for this relationship: (1) receiving cash transfers (informal or formal), (2) asset ownership, (3) access to agricultural input and output markets, (4) social networks, and (5) income diversification. In all regression specifications, we check if the coefficient estimates from the overall sample differ when we focus on female-headed and male-headed households separately.

5 Empirical findings

Table 1 provides the estimation results of our main regression. Model 1 tests the association between FCS and shock exposure using the overall sample. We find that climate shock does not significantly impact on FCS on average after we control for covariates and state-level fixed effects. This may be related to households' previously developed coping strategies or informal insurance concerning food consumption during climate shocks, which are more predictable than violent conflicts. However, conflict exposure in the previous three months decreases the FCS by 4.43 points, which is around 8.3% of the average FCS in the sample. Models 2 and 3 separately analyse the same relationship for female- and male-headed households. We find that conflict exposure results in a larger decrease in FCS for male-headed households; however, it is important to note that the average FCS is already six points lower for female-headed households. Therefore, a smaller coefficient may be related to the already low levels of FCS for these households in Model 2.

In Models 4 and 5, we first test if a polycrisis situation (i.e. households experiencing both climate and conflict shocks during the same period) affects households differently by adding the interaction term between climate shock exposure and violent conflict exposure. Of the households in our sample, 13.5% reported having experienced climate shocks and violent conflicts simultaneously. By comparison, 53% reported experiencing climate shocks only, and 19.2% had experienced only violent conflict in the three months previous to the survey date. Regression results show that the polycrisis variable is not significant, although it is found to be negative for female-headed households. Notably, the negative association between conflict exposure and the FCS of male-headed households is robust in all models.

Table 1: Conflict and climate shock exposure's impact on FCS

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Female HHH	Male HHH	All	Female HHH	Male HHH
Climate shock	.573	1.236	.367	.374	1.683	.084
	(.735)	(1.171)	(.808)	(.484)	(1.311)	(.927)
Conflict shock	-4.433***	-2.714*	-4.987***	-5.193***	-1.434	-6.153***
	(.922)	(1.525)	(.956)	(.904)	(2.351)	(1.31)
Climate X conflict				1.151	-1.96	1.759
				(1.091)	(2.677)	(1.565)
Constant	47.255***	39.391***	48.044***	47.353***	39.082***	48.17***
	(2.446)	(3.782)	(2.491)	(1.278)	(3.789)	(2.508)
Observations	7908	1337	6571	7908	1337	6571
R-squared	.102	.106	.093	.102	.107	.093
Covariates	YES	YES	YES	YES	YES	YES
State fixed effects	YES	YES	YES	YES	YES	YES
Mean of FCS	53.609	48.702	54.608	53.609	48.702	54.608

Note: heteroscedasticity-consistent standard errors are in parentheses. Models 1 and 4 include age, gender, and education of household heads (HHH) as covariates. Other models include age and education of HHH, while gender of HHH is used to construct the subsamples. State fixed effects are included in all models. *** p<.01, ** p<.05, * p<.1.

Source: authors' estimations.

Second, we test whether cash transfers (informal or formal) play any mitigating role in the impact of climate and conflict shocks on food security. As the urban migration of male household members (mainly heads) is an important phenomenon for rural households in Sudan, we first test whether receiving remittances (as a form of informal cash transfer) changes the impact of conflict exposure. Panel (a) in Table 2 presents the results. There are two important takeaways from these findings. Firstly, receiving remittances significantly increases the FCS of households in the total sample (Model 1). Secondly, we find that this significant impact of remittances is mainly through female-headed households. When we compare female-headed households that receive remittances with those that do not, we see that the negative impact of violent conflict on food security disappears for the former, while non-receiving households experience a decreasing effect of conflict exposure on FCS. Moreover, Model 3 shows that in male-headed households the negative impact of conflict exposure on FCS is larger than the positive contribution of receiving remittances.

Table 2: Cash transfers as a channel to mitigate the impact of shock exposure on FCS

(a) Informal cash transfer	(1)	(2)	(3)	(4)	(5)
	All	Female HHH	Male HHH	Female HHH	Male HHH
Remittance	2.762***	3.672***	2.576***	2.738	2.313
	(.812)	(1.42)	(.992)	(2.339)	(1.527)
Gender of HHH	-2.364***				
	(.568)				
Climate shock	.567	1.138	.372	1.223	.318
	(.434)	(1.004)	(.482)	(1.069)	(.494)
Conflict shock	-4.434***	-2.688**	-4.993***	-3.415***	-4.896***
	(.564)	(1.15)	(.645)	(1.222)	(.664)
Climate shock X remit.				-.674	1.151
				(2.854)	(2.031)
Conflict shock X remit.				4.879	-1.831
				(3.09)	(2.436)
Constant	47.425***	39.743***	48.157***	40.11***	48.152***
	(1.274)	(2.821)	(1.397)	(2.847)	(1.401)
Observations	7908	1337	6571	1337	6571
R-squared	.103	.111	.094	.113	.094
State fixed effects	YES	YES	YES	YES	YES
Mean of DV	53.609	48.702	54.608	48.702	54.608
(b) Formal cash transfer	(1)	(2)	(3)	(4)	(5)
	ALL	Female HHH	Male HHH	Female HHH	Male HHH
Cash transfer	-2.113*	2.484	-3.491**	.506	-1.75
	(1.257)	(2.465)	(1.485)	(5.255)	(3.945)
Gender of HHH	-2.105***				
	(.566)				
Climate shock	.622	1.166	.447	1.016	.522
	(.437)	(1.011)	(.485)	(1.027)	(.489)
Conflict shock	-4.418***	-2.716**	-4.956***	-2.591**	-5.131***
	(.565)	(1.157)	(.644)	(1.19)	(.655)
Climate shock X cash				4.156	-4.755
				(6.024)	(4.148)
Conflict shock X cash				-2.466	6.090**
				(5.237)	(3.085)
Constant	47.257***	39.425***	48.058***	39.414***	48.115***
	(1.273)	(2.823)	(1.396)	(2.831)	(1.397)
Observations	7908	1337	6571	1337	6571
R-squared	.102	.107	.094	.107	.094
State fixed effects	YES	YES	YES	YES	YES
Mean of DV	53.609	48.702	54.608	48.702	54.608

Note: heteroscedasticity-consistent standard errors are in parentheses. Model 1 includes age, gender, and education of household heads (HHH) as covariates. Other models include age and education of HHH, while gender of HHH is used to construct the subsamples. State fixed effects are included in all models. *** p<.01, ** p<.05, * p<.1.

Source: authors' estimations.

Panel (b) of Table 2 shows the results of our analysis of the role of cash transfers from NGOs and government institutions. We find that the association between FCS and the dummy variable of receiving formal cash transfers is negative in Models 1 and 3, which may reflect the role of targeting in cash transfer programmes that target the most vulnerable households. Therefore, we expect to find that the association between receiving a cash transfer and FCS is negative in our cross-sectional data. Importantly, Model 6 shows that receiving cash transfers during a violent conflict positively correlates with FCS in male-headed households. However, we do not find a similar role in female-headed households. Thus, our findings imply that formal cash transfers can be part of social protection programme design, particularly for male-headed households during violent conflict.

The third mechanism that we test is the role of asset ownership. We divide assets into two groups, namely non-productive and productive assets. Non-productive assets include food stations, refrigerators, mobile phones, stoves, TVs, radios, jewellery, and washing machines. Although we designate this group of assets as non-productive, such assets can indirectly increase the labour supply for agricultural production. The productive asset category includes assets that directly contribute to agricultural production, such as bicycles, cars, carts, water tanks, wheelbarrows, hoes, machetes, ox ploughs, and tractors. To calculate these asset indices, we first check if a household has any of these assets, using binary variables (yes or no). Then we sum up the total number of household assets for each category separately. Thus, a one-unit increase implies having one more asset type in a specific category, i.e. productive or non-productive.

Table 3: Asset ownership as a mitigation channel for the impacts of climate and conflict shocks

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Female HHH	Male HHH	All	Female HHH	Male HHH
Non-productive asset	3.186***	3.889***	3.072***	3.488***	3.909***	3.392***
	(.194)	(.526)	(.21)	(.27)	(.722)	(.404)
Productive asset	2.735***	2.845***	2.729***	2.62***	1.991***	2.729***
	(.164)	(.396)	(.181)	(.237)	(.552)	(.331)
Climate shock	.528	1.281	.31	1.87**	-.354	2.117
	(.413)	(.943)	(.459)	(.78)	(1.842)	(1.615)
Conflict shock	-4.474***	-2.196**	-5.157***	-7.002***	-5.044**	-7.812***
	(.53)	(1.087)	(.604)	(.963)	(2.034)	(1.512)
Prod. X climate				-.175	.748	-.289
				(.315)	(.795)	(.515)
Prod. X conflict				.893**	1.949**	.65
				(.387)	(.841)	(.522)
Non-prod. X climate				-.74**	.359	-.858
				(.357)	(.938)	(.538)
Non-prod. X conflict				.604	-.539	.947
				(.49)	(1.216)	(.586)
Constant	43.293***	33.597***	44.61***	43.123***	35.091***	44.176***
	(1.204)	(2.614)	(1.321)	(1.261)	(2.724)	(2.25)
Observations	7908	1337	6571	7908	1337	6571
R-squared	.186	.208	.176	.188	.213	.178
State fixed effects	YES	YES	YES	YES	YES	YES
Mean of DV	53.609	48.702	54.608	53.609	48.702	54.608

Note: heteroscedasticity-consistent standard errors are in parentheses. Models 1 and 4 include age, gender, and education of household heads (HHH) as covariates. Other models include age and education of HHH, while gender of HHH is used to construct the subsamples. State fixed effects are included in all models. *** p<.01, ** p<.05, * p<.1.

Source: authors' estimations.

Table 3 shows that both productive and non-productive assets increase the FCS of female- and male-headed households. This finding is robust across all the model specifications. Again, conflict exposure is significantly negatively associated with households' food security. Models 2 and 3 show that asset indices correlate more with FCS in female-headed households. Moreover, Model 4 presents evidence about the increasing role of productive assets during conflict exposure. Model 5 clearly shows that it is female-headed households that cause this finding. That said, the association between asset ownership and FCS does not change with conflict exposure for male-headed households, as presented in Model 6. Thus, the provision of productive assets can be an effective treatment arm targeting the food security of female-headed households exposed to conflict, while providing assets increases households' food consumption irrespective of their exposure to climate and conflict shocks.

Fourth, we analyse the role of better access to agricultural input and output markets for rural households' food security. In the survey, we asked households how long (in minutes) it took them to travel (one-way) on foot from their home to the closest functioning input and output markets. The average walking distance to an input market in our sample was 70 minutes, while for output market access it was 58 minutes. Table 4 presents the results of our analysis. We find that the greater the distance to the input market, the lower the FCS. However, this relationship does not hold for female-headed households, although it is valid for male-headed households. Moreover, the last three columns show that the role of distance to output markets remains valid for male-headed households. In other words, we find that access to agricultural input and output markets matters for the FCS of male-headed households but is not significantly correlated with the food security of female-headed households. Notably, even the significant correlation we find for male-headed households is minimal.

Fifth, we test whether social networks affect households' FCS. Social network is proxied by membership of youth groups, women's groups, and farmers' associations. Table 5 presents the results. Model 1 shows that membership of all network types significantly increases the food consumption levels of households on average when we control for exposure to climate and conflict shocks.

Once we check the association between all these social network types and FCS by gender of household head, we find that female-headed households only benefit from membership of women's groups. As we would expect, women's group membership increases the FCS for female-headed households by 5.3 points on average. Notably, women's group membership is also positively related to the FCS of male-headed households, probably through wives' memberships. It is important to note that all three group memberships have a significant positive impact on male-headed households. At the same time, only women's group membership matters for female-headed households. Social protection programmes can target this gender inequality in access to social safety nets. The last three columns in Table 5 show that although association membership is generally positively related to household FCS, female-headed households do not receive any additional benefit from their social networks during climate and violent conflict exposure, while male-headed households receive positive benefits from membership of youth groups during climate shocks. That said, being a member of a farmers' group is negatively correlated with the FCS of male-headed households during violent conflict exposure.

Finally, we test whether income diversification can increase household FCS during climate and conflict shocks. In our survey, we asked respondents about their households' income sources. We created a dummy variable for a total of eight different income sources (the sale of crop produce, agricultural wage income, etc.), and then we generated an aggregate income diversification index for each household. Over the maximum of eight income sources, on average a household in our sample has two different income sources. Model 1 in Table 6 shows that income diversification

positively correlates with FCS. Notably, this relationship is stronger for female-headed households (Models 2 and 3) than for male-headed households, and it plays a crucial role in mitigating the negative impact of violent conflict on these households. Moreover, Model 4 shows that income diversification increases food security during climate and conflict shocks, and this association is statistically significant only for male-headed households.

Table 4: Access to agricultural input and output markets

	(1)	(2)	(3)	(4)	(5)	(6)
	All	Female HHH	Male HHH	All	Female HHH	Male HHH
Climate shock	.713	2.69*	.31	.874	2.078	.559
	(.641)	(1.519)	(.711)	(.593)	(1.4)	(.657)
Conflict shock	-4.589***	-2.726	-5.061***	-4.145***	-2.107	-4.707***
	(.816)	(1.742)	(.929)	(.762)	(1.594)	(.87)
Distance to input market	-.018***	.002	-.02***			
	(.005)	(.013)	(.006)			
Conflict X distance to input market	.003	.002	.002			
	(.007)	(.018)	(.008)			
Climate X distance to input market	-.001	-.017	.001			
	(.006)	(.017)	(.007)			
Distance to output market				-.008	.017	-.012**
				(.005)	(.013)	(.006)
Conflict X distance to output market				-.007	-.01	-.007
				(.008)	(.019)	(.009)
Climate X distance to output market				-.004	-.012	-.002
				(.007)	(.018)	(.007)
Constant	48.318***	38.533***	49.4***	47.792***	38.184***	48.883***
	(1.329)	(2.925)	(1.461)	(1.314)	(2.917)	(1.442)
Observations	7567	1308	6259	7704	1320	6384
R-squared	.108	.105	.101	.105	.103	.098
State fixed effects	YES	YES	YES	YES	YES	YES
Mean of DV	53.609	48.702	54.608	53.609	48.702	54.608

Note: heteroscedasticity-consistent standard errors are in parentheses. Models 1 and 4 include age, gender, and education of household heads (HHH) as covariates. Other models include age and education of HHH, while the gender of HHH is used to construct subsamples. State fixed effects are included in all models. *** p<.01, ** p<.05, * p<.1.

Source: authors' estimations.

Table 5: Social networks, shock exposure, and food security

	(1) All	(2) Female HHH	(3) Male HHH	(4) All	(5) Female HHH	(6) Male HHH
Climate shock	.625	1.388	.354	.587	.804	.495
	(.434)	(1.023)	(.48)	(.459)	(1.096)	(.506)
Conflict shock	-4.774***	-2.847**	-5.429***	-4.605***	-2.712**	-5.275***
	(.569)	(1.167)	(.648)	(.609)	(1.27)	(.693)
SSN: farmer group	3.333***	.284	3.796***	5.789***	-.347	7.058***
	(.856)	(2.205)	(.937)	(1.284)	(2.664)	(1.449)
SSN: women group	5.403***	5.331***	5.701***	5.489***	4.448*	6.327***
	(.956)	(1.806)	(1.128)	(1.475)	(2.376)	(1.808)
SSN: youth group	2.443***	-1.877	2.992***	-.009	-3.924	.412
	(.882)	(1.965)	(.988)	(1.434)	(2.892)	(1.614)
Farmer group X conflict				-3.006	1.168	-3.306
				(1.97)	(4.492)	(2.209)
Women group X conflict				.026	-.674	-.175
				(2.213)	(4.297)	(2.648)
Youth group X conflict				1.344	-.645	2.194
				(2.062)	(4.111)	(2.382)
Farmer group X climate				-3.405*	2.317	-4.676**
				(1.75)	(4.921)	(1.921)
Women group X climate				-.148	1.968	-.933
				(1.95)	(3.779)	(2.329)
Youth group X climate				3.824**	3.903	3.697*
				(1.782)	(3.912)	(2.002)
Constant	47.337***	39.326***	48.078***	47.431***	39.632***	48.074***
	(1.272)	(2.814)	(1.396)	(1.276)	(2.852)	(1.4)
Observations	7805	1326	6479	7805	1326	6479
R-squared	.117	.109	.111	.118	.111	.113
State fixed effects	YES	YES	YES	YES	YES	YES
Mean of DV	53.609	48.702	54.608	53.609	48.702	54.608

Note: heteroscedasticity-consistent standard errors are in parentheses. Models 1 and 4 include age, gender, and education of household heads (HHH) as covariates. Other models include age and education of HHH, while the gender of HHH is used to construct subsamples. State fixed effects are included in all models. *** p<.01, ** p<.05, * p<.1.

Source: authors' estimations.

Table 6: Income diversification and food security during climate and conflict shocks

	(1) All	(2) Female HHH	(3) Male HHH	(4) All	(5) Female HHH	(6) Male HHH
Income diversification	1.227***	2.676***	.904***	-.008	1.568	-.336
	(.271)	(.555)	(.306)	(.504)	(.982)	(.567)
Climate shock	.469	1.013	.293	-2.669**	-1.658	-2.969**
	(.437)	(.999)	(.486)	(1.152)	(2.444)	(1.295)
Conflict shock	-4.561***	-3.153***	-5.065***	-7.03***	-4.299*	-7.755***
	(.562)	(1.149)	(.643)	(1.241)	(2.469)	(1.452)
Climate X income diversification				1.573***	1.392	1.621**
				(.561)	(1.169)	(.63)
Conflict X income diversification				1.228**	.6	1.326**
				(.554)	(1.117)	(.647)
Constant	44.463***	34.129***	45.954***	46.531***	35.936***	48.032***
	(1.409)	(3.117)	(1.551)	(1.576)	(3.403)	(1.746)
Observations	7908	1337	6571	7908	1337	6571
R-squared	.105	.123	.095	.107	.125	.097
State fixed effects	YES	YES	YES	YES	YES	YES
Mean of DV	53.609	48.702	54.608	53.609	48.702	54.608

Note: heteroscedasticity-consistent standard errors are in parentheses. Models 1 and 4 include age, gender, and education of household heads (HHH) as covariates. Other models include age and education of HHH, while gender of HHH is used to construct subsamples. State fixed effects are included in all models. *** p<.01, ** p<.05, * p<.1

Source: authors' estimations.

6 Conclusion

This paper has examined the role of conflict and climate shock exposure in households' food consumption, using the case of Sudan just before the onset of the country's current crisis. We have analysed primary survey data collected from 8,146 households residing in 353 villages across 14 states of Sudan. In addition to providing evidence about the gendered effect of conflicts on households' food security, we have also presented potential channels to increase food security during conflict exposure. Thus, our analyses provide insights into the social protection programmes that aim to increase the resiliency of households during conflict exposure.

Several key findings can be extracted from our empirical findings. We have shown that instead of climate shock exposure, it is mainly conflict exposure that negatively affects households' food security, disproportionately affecting female-headed households. This suggests that male-headed households may be more vulnerable to the immediate disruptions caused by conflict, despite the lower baseline FCS observed in female-headed households. As climate shocks (droughts and floods) are experienced cyclically in Sudan, households are developing adaptive capacities to cope with the negative impact of climate shocks on their food consumption. Our results indicate that the coping mechanisms developed by households in anticipation of climate shocks, along with the more predictable nature of these events compared with violent conflicts, may shield households from the adverse effects of climate variability. Further research may identify these adaptive capacity changes in households as a response to climate shocks.

In exploring potential mitigating factors, our paper has highlighted the critical role of cash transfers, both formal and informal. The analysis has shown that remittances significantly enhance FCS, particularly among female-headed households, effectively counteracting the negative impact

of conflict exposure. This underscores the importance of remittance flows as a buffer against economic shocks in rural settings. Conversely, the analysis of formal cash transfers indicates a negative correlation with FCS, probably due to the targeting of these transfers towards the most vulnerable households, which may inadvertently result in lower average scores. However, the positive association between receiving cash transfers during violent conflicts and FCS in male-headed households suggests that targeted cash assistance can serve as an effective component of social protection programmes, particularly during crisis situations.

Our investigation of asset ownership has revealed that both productive and non-productive assets are positively associated with food security across household types, with a more significant effect observed for female-headed households. This finding implies that enhancing access to productive assets may serve as an effective strategy for improving food security, particularly for households affected by conflict. The results also demonstrate that the association between asset ownership and FCS remains robust even amid exposure to climate and conflict shocks, indicating the resilience-building potential of asset accumulation.

Market access emerges as another critical determinant of food security, particularly for male-headed households. Our analysis has shown that longer distances to agricultural input and output markets are correlated with lower FCS, underscoring the importance of infrastructure and the accessibility of agricultural markets for enhancing food security. However, the findings reveal that female-headed households are less affected by market access, suggesting that interventions may need to be tailored to address the unique challenges these households face, including limited market engagement or different reliance on local food systems.

Furthermore, this paper has highlighted the positive influence of social networks on food security, with membership of women's groups significantly increasing FCS for female-headed households. This suggests that social networks serve as crucial support systems, particularly for female-headed households. However, our analysis indicates that female-headed households do not derive additional benefits from other available social networks, such as farmers' associations and youth groups, during climate and conflict exposure periods. In contrast, male-headed households experience positive contributions from all of the types of social network included in our analysis. This disparity raises concerns about gender equity in access to social safety nets, and it highlights the need for policies that enhance the resilience of female-headed households.

Finally, the paper has emphasized the importance of income diversification as a strategy for increasing food security, particularly among female-headed households during conflict. The positive correlation between income diversification and food security reinforces the necessity for inclusive economic strategies that enhance resilience to external shocks. Households with a broader range of income sources are better positioned to absorb the impacts of climate and conflict shocks, suggesting that interventions promoting diverse income-generating activities might effectively bolster food security.

In conclusion, we advocate targeted social protection programmes that address gender disparities in access to resources and support systems to improve households' food security during conflict and climate shock exposure. The insights gained from this research underscore the need for multidimensional approaches to enhance household food security amid overlapping crises. Our findings show that strategies that incorporate cash transfers, asset provision, market accessibility, and the strengthening of social networks to foster resilience among vulnerable populations, particularly in the context of climate change and conflict, would result in decreasing food insecurity in such contexts.

References

Ahmed, A., M.M. Bakhtiar, D.O. Gilligan, J. Hoddinott, and S. Roy (2023). 'Private Transfers, Public Transfers, and Food Insecurity During the Time of Covid-19: Evidence from Bangladesh'. *Applied Economic Perspectives and Policy*, 45(4): 1901–21. https://doi.org/10.1002/aepp.13373

Asmamaw, M., S.T. Mereta, and A. Ambelu (2019). 'Exploring Households' Resilience to Climate Change-Induced Shocks Using Climate Resilience Index in Dinki Watershed, Central Highlands of Ethiopia'. *PLOS ONE*, 14(7): e0219393. https://doi.org/10.1371/journal.pone.0219393

Aweke, C.S., E. Lahiff, M.G. Wordofa, and J.Y. Hassen (2020). 'Household Food Insecurity and Hunger in Babile District, Ethiopia'. *International Journal of Social Economics*, 47(10): 1225–42. https://doi.org/10.1108/ijse-02-2020-0057

Baliki, G., M. Al Daccache, H. Ghattas, and T. Brück (2024). 'Short- and Medium-Term Impacts of Small-Scale Vegetable Support on Food Security: Evidence from Syria'. *Food Security*, 16(1). https://doi.org/10.1007/s12571-024-01460-1

Baliki, G., T. Brück, and W. Stojetz (2018). 'Drivers of Resilience and Food Security in North-East Nigeria: Learning from Micro Data in an Emergency Setting'. Final Report to FAO. Berlin: ISDC.

Brück, T., and M. d'Errico (2019). 'Reprint of: Food Security and Violent Conflict: Introduction to the Special Issue'. *World Development*, 119: 145–49. https://doi.org/10.1016/j.worlddev.2019.04.006

Brück, T., M. d'Errico, and R. Pietrelli (2019). 'The Effects of Violent Conflict on Household Resilience and Food Security: Evidence from the 2014 Gaza Conflict'. *World Development*, 119: 203–23. https://doi.org/10.1016/j.worlddev.2018.05.008

Cruwys, T., P. Fong, O. Evans, and J.A. Rathbone (2022). 'A Community-Led Intervention to Build Neighbourhood Identification Predicts Better Wellbeing Following Prolonged COVID-19 Lockdowns'. *Frontiers in Psychology*, 13. https://doi.org/10.3389/fpsyg.2022.1030637

Dasgupta, S., and E. Robinson (2022). 'Attributing Changes in Food Insecurity to a Changing Climate'. *Scientific Reports*, 12(1). https://doi.org/10.1038/s41598-022-08696-x

Depoortere, E., F. Checchi, F. Broillet, S. Gerstl, A. Minetti, O. Gayraud, V. Briet, J. Pahl, I. Defourny, M. Tatay, and V. Brown (2004). 'Violence and Mortality in West Darfur, Sudan (2003–04): Epidemiological Evidence from Four Surveys'. *The Lancet*, 364: 1315–20. https://doi.org/10.1016/S0140-6736(04)17187-0

Eltigani, E.E. (1995). *War and Drought in the Sudan: Essays on Population Displacement*. Gainesville: University Press of Florida.

FAO (2023). 'Special Report: 2022 FAO Crop and Food Supply Assessment Mission (CFSAM) to the Republic of the Sudan'. Rome: FAO. https://doi.org/10.4060/cc5009en

FAO, IFAD, UNICEF, WFP, and WHO (2023). 'The State of Food Security and Nutrition in the World 2023: Urbanization, Agrifood Systems Transformation and Healthy Diets Across the Rural-Urban Continuum'. Rome: FAO. https://doi.org/10.4060/cc3017en

Gebre, G.G., H. Isoda, D.B. Rahut, Y. Amekawa, and H. Nomura (2019). 'Gender Differences in Agricultural Productivity: Evidence from Maize Farm Households in Southern Ethiopia'. *GeoJournal*, 86(2): 843–64. https://doi.org/10.1007/s10708-019-10098-y

George, J., A. Adelaja, and D. Weatherspoon (2019). 'Armed Conflicts and Food Insecurity: Evidence from Boko Haram's Attacks'. *American Journal of Agricultural Economics*, 102(1): 114–31. https://doi.org/10.1093/ajae/aaz039

Goldsmith, P.D., K. Gunjal, and B. Ndarishikanye (2004). 'Rural-Urban Migration and Agricultural Productivity: The Case of Senegal'. *Agricultural Economics*, 31: 33–45. https://doi.org/10.1111/j.1574-0862.2004.tb00220.x

Ibnouf, F.O. (2011). 'Challenges and Possibilities for Achieving Household Food Security in the Western Sudan Region: The Role of Female Farmers'. *Food Security*, 3: 215–31. https://doi.org/10.1007/s12571-011-0118-3

IPC (2023). 'Sudan: Acute Food Insecurity Analysis, October 2022 – February 2023'. Available at: www.ipcinfo.org/ipc-country-analysis/details-map/en/c/1155716/?iso3=SDN (accessed 6 April 2023).

Jentsch, B. (2006). 'Youth Migration from Rural Areas: Moral Principles to Support Youth and Rural Communities in Policy Debates'. *Sociologia Ruralis*, 46(3): 229–40. https://doi.org/10.1111/j.1467-9523.2006.00412.x

Khan, Y., U. Daraz, and Š. Bojnec (2023). 'Enhancing Food Security and Nutrition Through Social Safety Nets: A Pathway to Sustainable Development'. *Sustainability*, 15(19): 14347. https://doi.org/10.3390/su151914347

Martin-Shields, C.P., and W. Stojetz (2019). 'Food Security and Conflict: Empirical Challenges and Future Opportunities for Research and Policy Making on Food Security and Conflict'. *World Development*, 119: 150–64. https://doi.org/10.1016/j.worlddev.2018.07.011

Mavodyo, E. (2023). 'The Impact of Climate Change on Food Insecurity in the Southern African Development Community'. *Journal of Developing Economies*, 8(1): 162–83. https://doi.org/10.20473/jde.v8i1.43534

Mwai, E., A. Ojore, and N. Tobias (2023). 'Effects of Climate Change on Women's Food Security in Mwea East Sub-County, Kirinyaga County, Kenya'. *Eastern African Journal of Humanities and Social Sciences*, 2(2): 38–48. https://doi.org/10.58721/eajhss.v2i2.318

Naveed, S., A.I. Malik, and I.H. Adil (2023). 'The Role of Public Versus Private Social Safety Nets in Mitigating the Impact of Shocks in Rural Pakistan'. *Humanities and Social Sciences Communications*, 10(1). https://doi.org/10.1057/s41599-023-01570-9

Ndjobo, P.M.N. (2023). 'Gender Inequality in Asset Ownership and Women's Food Security in Sub-Saharan Africa'. *African Development Review*, 35(1): 24–37. https://doi.org/10.1111/1467-8268.12679

Niles, M.T., and J.D. Salerno (2018). 'A Cross-Country Analysis of Climate Shocks and Smallholder Food Insecurity'. *PLOS ONE*, 13(2): e0192928. https://doi.org/10.1371/journal.pone.0192928

Nnaji, A., W. Ma, N. Ratna, and A. Renwick (2022). 'Farmer-Herder Conflicts and Food Insecurity: Evidence from Rural Nigeria'. *Agricultural and Resource Economics Review*, 51(2): 391–421. https://doi.org/10.1017/age.2022.9

Onyenekwe, C.S., U.T. Okpara, P.I. Opata, I.S. Egyir, and D.B. Sarpong (2022). 'The Triple Challenge: Food Security and Vulnerabilities of Fishing and Farming Households in Situations Characterized by Increasing Conflict, Climate Shock, and Environmental Degradation'. *Land*, 11(11): 1982. https://doi.org/10.3390/land11111982

Riley, L., and M. Caesar (2018). 'Urban Household Food Security in China and Mozambique: A Gender-Based Comparative Approach'. *Development in Practice*, 28(8): 1012–21. https://doi.org/10.1080/09614524.2018.1505829

Ronzani, P., W. Stojetz, C. Azzarri, G. Nico, E. Mane, and T. Brück (2024). 'Armed Conflict and Gendered Participation in Agrifood Systems: Survey Evidence from 29 African Countries'. Working Paper 409. Berlin: Households in Conflict Network. Available at: https://hicn.org/wp-content/uploads/2024/03/HiCN-WP-409.pdf (accessed 20 November 2024).

Shemyakina, O. (2022). 'War, Conflict, and Food Insecurity'. *Annual Review of Resource Economics*, 14(1): 313–32. https://doi.org/10.1146/annurev-resource-111920-021918

Stojetz, W., P. Ronzani, J. Pinay, M. D'Errico, and T. Brück, (2024). 'Shocking Social Safety: Evidence from Violence and Drought in North-East Nigeria'. Working Paper 2024/420. Berlin: Households in Conflict Network.

Verwimp, P., P. Justino, and T. Brück (2019). 'The Microeconomics of Violent Conflict'. *Journal of Development Economics*, 141: 102297. https://doi.org/10.1016/j.jdeveco.2018.10.005

Vesco, P., G. Baliki, T. Brück, S. Döring, A. Eriksson, H. Fjelde, D. Guha-Sapir, J. Hall, C.H. Knutsen, M.R. Leis, H. Mueller, C. Rauh, I. Rudolfsen, A. Swain, A. Timlick, P.T.B. Vassiliou, J. von Schreeb, N. von Uexkull, and H. Hegre (2024, forthcoming). 'The Impacts of Armed Conflict on Human Development: A Review of the Literature'. *World Development*.

Weiffen, D., G. Baliki, and T. Brück (2022). 'Violent Conflict Moderates Food Security Impacts of Agricultural Asset Transfers in Syria: A Heterogeneity Analysis Using Machine Learning'. Working Paper 381. Berlin: Households in Conflict Network.

Weldegiargis, A.W., H.T. Abebe, H.E. Abraha, M.M. Abrha, T.B. Tesfay, R.E. Belay, A.A. Araya, M.B. Gebregziabher, H, Godefay, and A. Mulugeta (2023). 'Armed Conflict and Household Food Insecurity: Evidence from War-Torn Tigray, Ethiopia'. *Conflict and Health*, 17: 22. https://doi.org/10.1186/s13031-023-00520-1

WFP (2024a). 'WFP Syria Situation Report #12—December 2023'. Available at: https://reliefweb.int/report/syrian-arab-republic/wfp-syria-situation-report-12-december-2023 (accessed 20 November 2024).

WFP (2024b). 'WFP Yemen Food Security Update, February 2024'. Available at: https://reliefweb.int/report/yemen/wfp-yemen-food-security-update-february-2024 (accessed 20 November 2024).