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Plague, war, and exodus? The effects of desert locust swarms on migration intentions in Yemen

Yashodhan Ghorpade*

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Abstract: I study the effect of the 2019–21 desert locust outbreak on the intention to migrate among rural households and individuals in Yemen, as an illustration of the human mobility impacts of climate change-related shocks in a complex emergency setting. Using the first systematic household survey conducted in southern Yemen since the beginning of the ongoing conflict, I find that a one standard-deviation increase in exposure to desert locusts increases the individual willingness to migrate (internally or abroad) by 12 percentage points among rural residents. The effects are driven by agriculture-dependent households, plausibly due to the income shock experienced by them as a result of locust exposure. I rule out alternate explanations offered by the selective targeting of aid, selective locust control operations, or the exacerbation of underlying conflict, and argue that the findings are consistent with distress migration. Despite an increase in the willingness to migrate following locust outbreaks, very few people may actually be able to migrate as they lack the necessary resources. As migration intentions may not be realized, most of the affected population may instead be 'trapped'—willing but unable to migrate in response to a formidable natural disaster.

Key words: migration, locust, complex emergency, Yemen, climate change

JEL classification: O12, J61, J68, O15

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*UNU-WIDER, Helsinki, Finland and IZA, Bonn, Germany email yashodhang@gmail.com

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Katajanokanlaituri 6 B, 00160 Helsinki, Finland

1 Introduction

Desert locust swarms can have pernicious effects on household livelihoods, food security, and wellbeing, particularly in rural settings across countries in South and West Asia and Africa. Under the right mix of climatic and other conditions, the desert locust (*shistocerca gregaria*) can breed rapidly to form large swarms whose voracious appetite can very quickly target any vegetation—scrub, bush, crops, trees, weeds, or grass—leaving behind a massive trail of destruction. It is estimated that a locust swarm spread over one square kilometre can comprise up to 40 million individual locusts and consume the equivalent amount of food as that typically eaten by 35,000 persons in a day. A swarm the size of Rome can eat as much as the entire population of Kenya in one day (FAO 2024). According to experts[1] large locust swarms may destroy as much as 50–80 per cent of crops, depending on the time of the year. They represent a critical threat to crops and fodder that poor and rural populations depend upon for sustenance.

Anthropogenic climate change, resulting in higher temperatures, extreme weather events, anomalous precipitation, and the frequent occurrence of cyclones, can exacerbate the development of desert locust swarms. Recent outbreaks, particularly the 2019–21 desert locust plague, have been prompted by increasing climate change and extreme weather events (Devi 2020; Qiu 2009; Salih et al. 2020). As climate change intensifies, and in the absence of increased prevention measures, desert locust outbreaks may become more frequent, widespread, and destructive, posing a challenge to the lives and livelihoods of the most vulnerable.

Desert locust shocks may also exert greater pressures on population movements as affected people, who disproportionately include the rural, agro-pastoralist and poor communities who already face the brunt of climate change shocks, may seek to relocate from areas with diminished economic prospects. While recent studies have identified the negative effects of desert locust exposure on a range of outcomes including agricultural production (Ilukor and Gourlay 2021; Marending and Tripodi 2022), child health and nutrition (Conte et al. 2021; Le and Nguyen 2022; Marending and Tripodi 2022; Nguyen 2021), and education (de Vyreyer et al. 2015), less is known about the effects of locusts on human mobility. On the other hand the literature on the mobility effects of climate change and natural disasters (Belasen and Polachek 2013; Berlemann and Steinhardt 2017) comprises micro- and macro-level studies on extreme climate events such as temperature anomalies (Cai et al. 2016; Marchiori et al. 2012; Mastrorillo et al. 2016; Mueller et al 2014), rainfall shortages (Beine and Parsons 2015, 2017; Di Falco et al. 2012; Gray 2009; Gray and Billsborrow 2013; Gray and Mueller 2012a; Henry et al. 2004; Munshi 2003), excess precipitation (Dallmann and Millock 2017; Mastrorillo et al. 2016), and natural calamities (Bohra-Mishra et al. 2014; Drabo and Mbaye 2015) including droughts (Findley 1994), typhoons (Gröger and Zylberberg 2016), tornados and hurricanes (Boustan et al. 2012; Kugler and Yuksel 2008; Paul 2005), earthquakes (Halliday 2006, 2012), and floods (Dun 2011; Gray and Mueller 2012b), but not desert locust upsurges, as yet. As climate change intensifies and the likelihood, frequency, and damage of desert locust attacks rises, population mobility within and outside international borders may be affected in ways that have serious consequences for livelihoods and wellbeing, and that are not sufficiently understood. This paper speaks to this critical knowledge gap.

The studies on the effects of natural disasters on population movements provide some common findings; in many—but not all cases—natural disasters, especially those of higher intensity, induce short- and long-term out-migration (Belasen and Polachek 2013; Berlemann and Steinhardt 2017),

[1] Rick Overson, Research Scientist at the Arizona State University's Global Locust Initiative, quoted in Baskar (2020).

though less so for rural populations in general (Belasen and Polachek 2013). Rainfall deficits and high temperatures are also associated with higher out-migration, but the direction of the effects of excess rainfall vary by setting, with some studies finding opposite effects (Berlemann and Steinhardt 2017; Dallmann and Millock 2017). Gray and Bilsborrow (2013) further argue that the effects of natural disasters on human mobility are not linear or uniform. Effects greatly depend on underlying mechanisms and mediating factors.

How exposure to natural disasters affects migration depends on a range of mediating factors such as individuals' and households' endowments with respect to wealth, income, and liquidity (Findley 1994; Halliday 2006; Kugler and Yuksel 2008), education levels (Drabo and Mbaye 2011), and access to social networks (McKenzie and Rapoport 2010; Munshi 2003, 2011). Actions taken after the onset of a disaster may also moderate migration responses. For instance Paul (2005) attributes the low level of migration observed following a tornado in Bangladesh in 2004 to the timely provision of aid, which may have obviated the need for people to relocate. Similarly, post-disaster investments directed at reconstruction, both public and private, can raise the demand and consequently the marginal product of labour and provide better employment opportunities in affected areas, reducing the need for affected populations to seek work opportunities outside (Cappelini et al. 2010; Tse 2011). Finally, the effects of disasters on migration outcomes depend on the nature of the disaster itself, as the intensity, severity, deadliness, and timing (sudden v/s slow onset) may evoke different migratory responses. While some analyses have formalized how climate-induced migration may lead to conflict (Burrows and Kinney 2016), the mediating role of conflict on migration following natural disasters has been under-researched.

Exposure to natural disasters may affect the propensity to migrate through two opposite mechanisms. First, the economic shock induced by natural disasters, through lower agricultural productivity or the destruction of infrastructure, can dampen wages in affected migrant-sending areas, and increase the relative wage gap between source and destination. This can induce a greater 'pull' from migrant receiving areas, resulting in higher migration. In contrast the economic shock can also lower households' and individuals' incomes, reducing their ability to meet the costs of migration, and consequently discouraging movement. High intensity disasters may also deter individual movement by exacerbating the need for individuals to stay with their more immobile family members in a time of need, thereby raising the psychological or emotional costs of migrating. Which of these effects dominates is ultimately an empirical question determined by the relative strengths of each effect, which in turn may vary by individual and household characteristics and the effects of mediating factors.

In conflict-affected settings these considerations are further complicated by the extent to which the pecuniary and non-pecuniary costs of migration are affected by conflict exposure. Safety concerns are non-trivial considerations in determining migration choices, as movements in conflict-affected areas may come at significant psychological, physical, and monetary costs. Robalino et al. (2015) find that more severe disasters that entail a loss of life actually deter migration, a finding that underlines the importance of physical safety concerns in determining how people cope with shocks. Other factors, such as the actions of state and non-state actors in ex-ante disaster risk-reduction, ex-post disaster risk-mitigation, and their regulation of population movements as well as changed economic and social dynamics in conflict-affected areas, may be other ways in which conflict mediates the impact of natural disasters on mobility. Taken together these factors underline why one cannot simply extend findings from other natural disasters and countries to the complex emergency setting of the 2019–21 desert locust plague in Yemen, a low-income country in the midst of a civil war. The complexities of the setting necessitate dedicated empirical analysis, which can be instructional for understanding migration responses to natural disasters, especially desert locust outbreaks, in a range of other low-income and complex emergency settings.

This paper examines the impact of the 2019–21 desert locust plague on the willingness to out-migrate (within Yemen or abroad) among rural households and individuals in southern Yemen. The severe plague coincided with a time marked by ongoing civil war, the COVID-19 pandemic, existing high levels of poverty, food insecurity and economic stagnation, and unmet humanitarian needs, making this a complex emergency that had critical development and humanitarian ramifications.

In this paper I focus on the intention to migrate as the main variable of interest for a number of reasons. First, while not all those who intend to migrate may actually be able to, the intention to migrate may be thought of as an upper-bound estimate of eventual migration flows. Studies have also demonstrated that migration intentions are strong predictors of migration decisions (Docquier et al. 2014; Tjaden et al. 2019) and that both are driven by similar factors (Huber and Nowtony 2020). Many recent studies have specifically examined migration intentions (Clifton-Sprigg 2022; Hoffman et al. 2015; Huber and Nowtony 2020; Otrachshenko and Popova 2014) and their determinants (Becerra 2012; Epstein and Gang 2006; Falco and Rotondi 2016) as important outcomes themselves. Studying migration intentions may be particularly useful in a context such as Yemen, where opportunities for conducting surveys are rare. Migration intentions may be a good proxy for migration, given that the latter is a less frequent occurrence that is harder to study using a finite survey dataset. Moreover, when people are likely to migrate illegally, it is much harder to survey them in destination areas, making pre-movement assessments of migration intentions very valuable to the study of drivers and expectations (Mbaye 2014).

I combine data from a rich and detailed representative household survey, the Yemen Human Development Survey (YHDS 2022), conducted in southern Yemen in 2021 with data from the Food and Agriculture Organization (FAO 2023a, 2023b) on the location of desert locust swarms and locust control operations and with conflict event data from the Armed Conflict Location Event Dataset (ACLED 2023) to delineate the effects of desert locust exposure on migration intentions. I find that a one standard-deviation increase in the exposure to desert locust swarms increases individual willingness to migrate by over 13 percentage points, representing around 50 per cent of the average willingness to migrate in the sample. These effects are larger for agricultural and livestock-dependent households and individuals and for less-educated individuals. I rule out that these effects may be driven by selective locust control operations, any conflation with post-locust distribution of humanitarian aid, or the exacerbation of conflict by locust attacks. Instead I find evidence to indicate that locust-induced migration intentions are a response to an economic shock; locust exposure reduces household and individual wellbeing and drives higher willingness to migrate among those who are economically worse off, consistent with patterns of distress migration. However, while locust exposure drives the desire to migrate in relatively more peaceful areas, it appears to deter migration intentions in high-conflict areas. This suggests that conflict and security considerations mediate the effect of locust outbreaks on mobility, underlining the need for a more granular understanding of mobility and coping dynamics in complex emergency settings.

The remainder of this paper is organized as follows. Section 2 describes the context of the study areas in Yemen and the 2019–21 desert locust plague. Section 3 describes the data sources used in the analysis. Section 4 presents the identification strategy. Section 5 presents the results, and Section 6 explores alternate mechanisms and heterogeneities that outline the pathways of impact. Section 7 discusses the implications of the results and Section 8 provides an overview of robustness tests. Section 9 concludes with implications for future research and policy.

2 Empirical setting

Yemen has remained one of the poorest and most food-insecure countries in the world over the last few decades (World Bank 2007). The 2019 International Food Policy Research Institute Global Hunger Index (GHI) ranked Yemen 116 out of 117 countries (GHI 2019). This has translated into high levels of human deprivation, as evident in the estimated rates of child stunting (61.1 per cent) and wasting (17.9 per cent)(GHI 2019), and famine risk (an estimated 16.2 million people, roughly half its population, would have faced high levels of acute food insecurity— Integrated Food Security Phase Classification (IPC) Phase 3 or above—in the first half of 2021) (World Bank 2021). While chronic poverty and underemployment resulted in high food insecurity over many years (World Bank 2007), the onset of civil war in 2015 intensified economic contraction and hunger (World Bank 2021). The withdrawal of fuel subsidies in 2014 precipitated agitations against the Government of Yemen, leading to a takeover of the capital city of Sana'a by the Houthi armed group and the displacement of the incumbent Internationally Recognized Government (IRG) to Aden in the south. This was followed by Saudi Arabian airstrikes against Houthi-held territories in the north, as well as violent contestation in areas held by the IRG involving actors such as Al Qaeda in the Arabian Peninsula and the UAE-backed Southern Transition Council. While occasional ceasefires (in 2015, 2016, 2018, and 2020) and peace talks (including Geneva in 2015, Kuwait in 2016, Stockholm in 2018, Riyadh in 2019) were attempted, these did not hold for long.

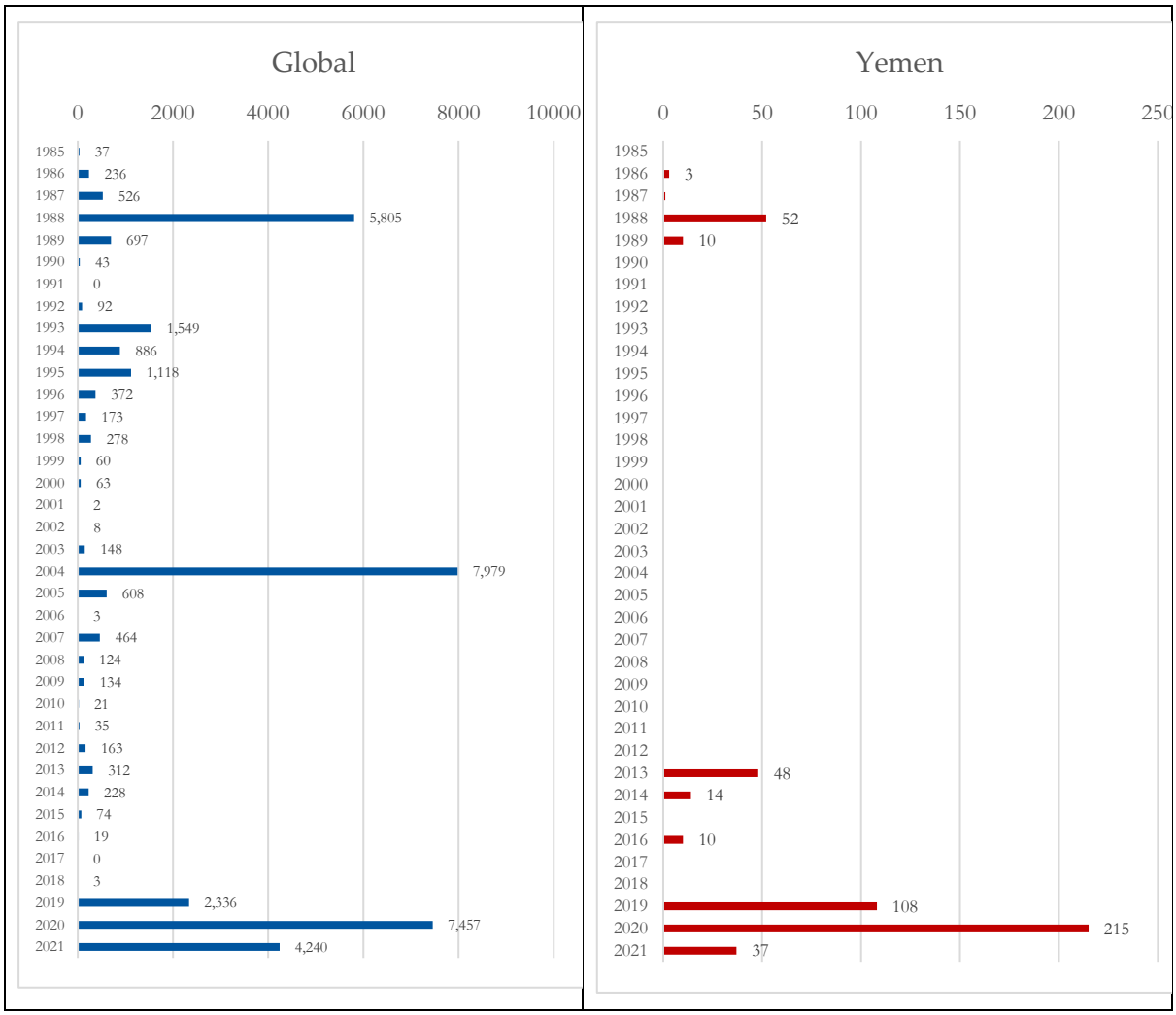
The United Nations Development Programme (UNDP) estimates that conflict between 2015 and 2021 claimed around 377,000 lives, of which around 60 per cent were lost to indirect effects such as the lack of access to water, food, and healthcare (UNDP 2021). The humanitarian needs assessment for 2022 (UN OCHA 2022) found that 23.4 million people (over 70 per cent of the population) were in need of humanitarian support. The prolonged conflict has challenged, and may even have set back development outcomes by as much as 21 years in 2019, through an intensification of poverty, the lack of access to critical services, and related deprivations (Moyer et al. 2019). Against this backdrop Yemen has also faced multiple and successive shocks, including episodes of flooding, a cholera outbreak in 2018, internal displacement of around 4.3 million people IDMC (2024), and sustained depreciation of the Yemeni Rial (YER) resulting in high inflation, particularly of imported commodities such as food and fuel, leading to one of the worst complex emergencies in recent history. Despite the growing humanitarian needs, funding support has in fact seen a sharp decline, from US$3.64 billion in 2019 to US$1.38 billion in August 2023—a reduction of over 60 per cent (Save the Children 2023). By the time the desert locust crisis of 2019–21 struck, Yemen's population had already been enfeebled and rendered vulnerable, with very limited capacity to withstand yet another shock.

2.1 The 2019–21 desert locust plague in Yemen

The 2019–21 desert locust plague was the outcome of the blighted concatenation of individually improbable climatic, edaphic, and human (in)action-related phenomena. Its origins lay in the high levels of cyclonic activity over the Arabian Sea in 2018 making landfall over the sparsely populated sandy desert tracts over *Rub-al Khali,* 'the Empty Quarter', spread across Yemen, Oman, Saudi Arabia, and the UAE. Cyclone Mekunu in May 2018 brought unseasonal heavy rains over these large desert tracts, creating conditions for the propagation of desert locusts. While the locusts would typically have died out under normal patterns of dry weather, the persistence of the heavy cyclone activity over the Arabian Sea in the following months, including cyclone Luban in October 2018, prolonged the moist and humid conditions necessary for another generation of breeding. The swarms grew in size by 8,000 times, instead of the usual 400 times (Ahmed 2020). This was followed by an exceptionally positive phase of the Indian Ocean Dipole (IOD)—an irregular phenomenon that results in the oscillation of sea surface temperatures of the eastern and western

sides of the Indian Ocean (on either side of the Indian peninsula) resulting in surplus and deficient rainfall on each side, respectively.[2] This exceptionally positive phase of the IOD in 2019, one of the strongest in the last 60 years and the highest in the last 40 years (Johnson 2020), resulted in uncharacteristically high temperatures and consistent rainfall—propitious conditions for the unprecedented breeding of desert locusts. Developing first in Yemen, the swarms subsequently crossed over the Gulf of Aden into Djibouti, Ethiopia, Somalia, Kenya, Sudan, and as far as the Sahel for the first time in 70 years (Kimathi et al. 2020; Mongare et al. 2023). Figure 1 shows the number of desert locust swarms recorded by year in Yemen and globally, between 1985 and 2021.

Figure 1: The number of desert locust swarms by year



Source: author's calculations using data from the FAO Desert Locust Hub—Locust Swarms data (FAO 2023a).

The predisposition to large locust swarms because of unprecedented climatic conditions was exacerbated by the prevailing political situation in Yemen. Ongoing conflict resulting in the division and weakening of Yemen's once effective locust monitoring capacity meant that the country was not able to conduct control operations at the scale necessary to prevent a desert locust crisis (Ahmed 2020). The ongoing conflict also limited the access of researchers and humanitarian workers to conduct monitoring and relief missions as well as critical control interventions that must be initiated in early phases (Kennedy 2020; Roussi 2020). Requisite funding for effective

[2] The positive IOD was also responsible for rainfall shortfalls in Australia in 2019 and subsequent bushfires.

locust monitoring and control operations was also not sufficiently available in Yemen (Kennedy 2020) or in other affected countries in Africa such as Somalia, Sudan, Djibouti, and Uganda (Roussi 2020). Supply chain disruptions during the COVID-19 pandemic further impeded and delayed control measures, as insecticides and other equipment were unavailable at a time when and in places where they were most needed (Baskar 2020).[3] This unique combination of natural and human factors led to Yemen being termed by experts[4] as the 'frontline' country in the 2019–21 desert locust crisis, resulting in unchecked and unabated exposure to large desert locust swarms for large segments of its vulnerable population.

3 Data

This paper uses household data collected in the Yemen Human Development Survey (YHDS) between August and November 2021. The YHDS is a representative survey of areas under the control of the IRG of Yemen as of 2021, often referred to as South Yemen. The survey was conducted by the Yemen Social Fund for Development, the World Bank, and the UNDP across 1,681 households spread over 105 enumeration areas (of which 50 were urban and 55 rural). The survey is representative of the four regions under the IRG, urban and rural locations, and internally displaced persons (IDP) and non-IDP households. It includes modules on household and individual characteristics including demographics, economic activity and labour market indicators, income, consumption, asset ownership, migration intentions, displacement, shocks and coping strategies, and living conditions.

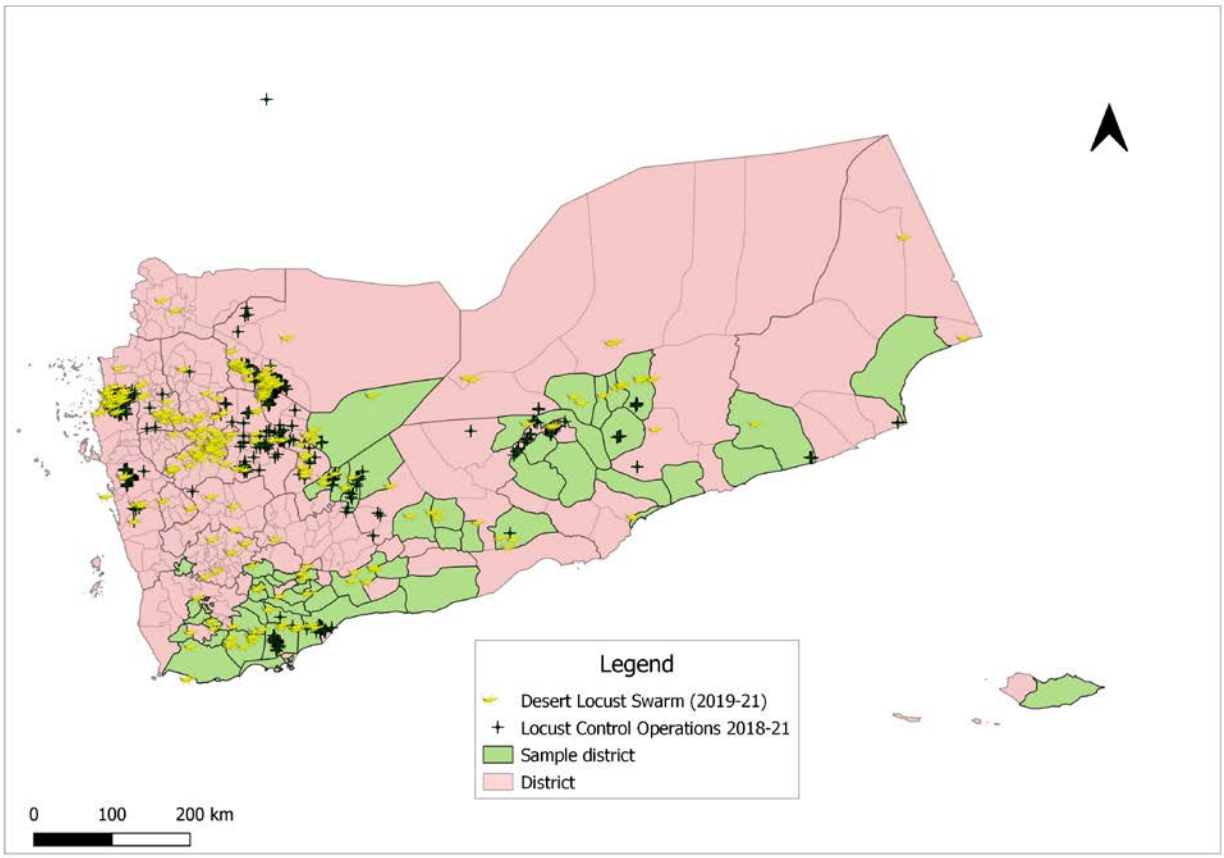
Household survey data from the YHDS is combined with data on locust exposure from the FAO Locust Hub, and conflict event data from ACLED. The 'Locust Hub' maintained by the FAO is an online repository of critical information on locust infestations worldwide. It provides data on the geographical location of locust swarms since 1985 as well as locust control operations. For this paper I specifically use data on the location of desert locust swarms and control operations from January 2019 until July 2021 (just before the beginning of the YHDS fieldwork).[5] As Figure 2 indicates, there were relatively few locust control operations close to the survey enumeration areas. In fact over 86 per cent of the surveyed population in rural areas (and 85 per cent overall) resided in districts with no locust control operations whatsoever.

[3] Also see World Bank (n.d.).

[4] Keith Cressman, Locust Forecasting Expert for the UN's FAO, as reported in Ahmed (2020)

[5] The data are available publicly (see FAO 2023b). This data source has been used as a credible source of information on locusts in scientific studies such as Mongare et al. (2023).

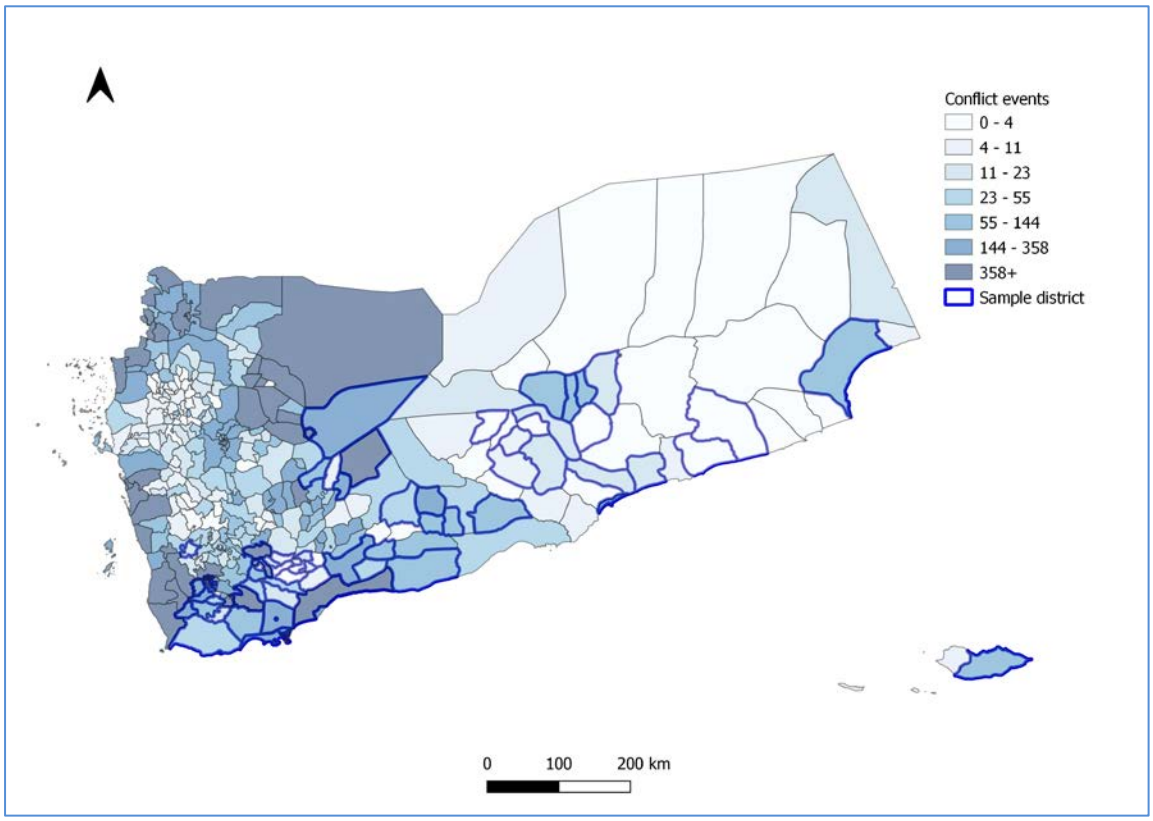
Figure 2: Location of desert locust swarms, locust control operations, and YHDS sample districts



Source: author's illustration using data from FAO (2023b).

ACLED is a global repository of geo-coded conflict event data which contains detailed information on aspects such as the count and type of conflict events (such as battle deaths, remote violence involving explosives, attacks against civilians, protests, and riots) by date and location, as well as fatalities in these events (see Raleigh et al. 2023). For this paper I focus on conflict exposure over the period from January 2015 to July 2021, coinciding with the civil conflict that began in 2015 until just before the start of fieldwork for the YHDS. I use two measures of conflict exposure: the sum of distinct conflict events and that of fatalities in conflict, both in a 25-km radius from the centroid of each enumeration area. Figure 3 shows the district-level intensity of conflict events in Yemen from January 2015 to July 2021.

Figure 3: District-level conflict intensity in the YHDS (using the number of conflict events from January 2015 to July 2021)



Source: author's illustration using data from ACLED (2023).

4 Identification

I identify the causal effects of locust exposure on migration intentions by comparing survey respondents' willingness to migrate across enumeration areas with varying distance to the nearest locust swarm. The treatment is therefore the distance to the nearest locust swarm which may be thought of as representing varying degrees of exposure to locust swarms, with shorter distances signifying greater locust exposure. The distance is calculated based on the observed distance between the locust swarms identified in the FAO Locust Hub database and the location of enumeration areas. Given the highly unlikely combination of weather, climate, and edaphic factors required to result in the type of locust crisis experienced in Yemen in 2019–21, locust exposure is very likely beyond the influence of individual actions of the survey respondents. Endogeneity between the location of locust swarms and individual migration intentions could arise because of any omitted variables that simultaneously affect individual migration intentions and conditions for the development of locust swarms. I overcome this using two alternate approaches. First, I control for the mean temperature, soil moisture, and soil sand content, which are critical climato-edaphic correlates of locust swarm development (Kimathi et al. 2020; Mongare et al. 2023) that, through their implications for agricultural productivity, may also affect people's migration intentions. I also use alternate measures of locust exposure, including the average distance to the nearest three, five, and ten locust swarms, as well as a count of locust swarms located in a 30-, 40-, and 50-km radius for each enumeration area to address any concerns of measurement error.

The measure of locust exposure is defined as:

$$L_j = (-1) * z(\text{Distance})_j \quad (1)$$

where $z(\text{Distance})_j$ is the standardized distance of the enumeration area *j* to the nearest locust swarm observed between 2019 and June 2021. The standardized distance is multiplied by -1 for interpretational ease such that higher values of the Lj represent greater exposure to locust swarms (through shorter distances to the nearest swarm).

The causal relationship of interest is expressed as equation (2):

$$Y_{ij} = \alpha + \beta_1 L_j + \beta_2 X_{ij} + \beta_3 R + \varepsilon_{ij} \quad (2)$$

where Y_{ij} is the likelihood that individual i in location j intends to migrate, L is the measure of locust exposure as defined in (1), X is the matrix of individual, household, and community-level controls, and R is the matrix of regional dummies. β_1, which represents the conditional effect of locust exposure on people's migration intentions, is the main coefficient of interest.

5 Results

I first present descriptive statistics of key variables in the analysis (Table 1). Twenty-six per cent of the individuals aged 14 and above in the sample (rural) areas said they would like to migrate. Roughly 60 per cent of these would like to migrate abroad, while the other 40 per cent would like to migrate within Yemen. The sample had a median age of 35 years, showed a strong dependence on agricultural livelihoods, and was, on average, within a 19-km minimum distance from a locust swarm.

Table 1: Descriptive statistics

	Mean	Std. dev.	N
Individual-level variables			
Individual would like to migrate	0.288	0.453	3,109
Individual would like to migrate abroad	0.599	0.490	864
All HH members would like to migrate together	0.679	0.467	1,117
Age	35.0	17.0	3,109
Male	0.461	0.499	3,109
No education	0.284	0.451	3,109
Education: up to primary	0.139	0.346	3,109
Education: above primary up to secondary	0.276	0.447	3,109
Education: above secondary up to degree	0.234	0.423	3,109
Education: degree and higher	0.062	0.241	3,109
Individual is part of labour force	0.419	0.494	3,109
Individual is currently employed	0.254	0.435	3,109
Currently displaced	0.037	0.190	3,109
Ever displaced since 2015	0.156	0.362	3,109
Displaced but returned	0.118	0.323	3,109
Individual employed in agriculture	0.122	0.328	3,109

Household level variables			
HH depends on agriculture	0.451	0.498	864
HH owns any livestock	0.628	0.483	864
HH owns buildings or non-agricultural land	0.424	0.494	864
HH owns agricultural land	0.307	0.461	864
HH received any aid	0.433	0.496	864
HH received cash assistance	0.177	0.382	864
HH received in-kind food assistance	0.280	0.449	864
HH received other in-kind assistance	0.052	0.222	864
Enumeration area-level variables			
Conflict events in 25-km radius since 2015	692	1,021	54
Fatalities in conflict in 25-km radius since 2015	1,879	2,772	54
Distance to nearest locust swarm (km)	18.7	18.9	54
No. of locust swarms in 30-km radius	4.7	3.3	54
No. of locust control operations in sub-district	1.9	5.2	54
No. of locust control operations in district	2.2	5.2	

Source: author's calculations.

Next, I examine the correlation of Lj with pre-locust characteristics of households and communities. I use data on the patterns of household asset ownership from before the onset of conflict in 2015 based on retrospective asset ownership questions as well as questions on household characteristics that would not have changed since the onset of the locust crisis. Tables 2 and 3 show that pre-locust household and community wealth and other characteristics do not bear any clear or strong association with the measure of locust exposure, confirming that locust exposure was not systematically correlated with wellbeing characteristics at the household and community levels.

Table 2: Ordinary least squares (OLS) regression coefficients of locust exposure on pre-2015 household asset ownership and other characteristics

	Coeff.	Std. err.	t	P>t	Mean
Non-agricultural land/ buildings	-0.072***	0.022	-3.250	0.001	0.273
Agricultural land	0.016	0.024	0.680	0.497	0.249
Private vehicle	0.036	0.028	1.280	0.200	0.169
Taxi	0.056	0.073	0.770	0.443	0.019
Minibus	-0.027	0.104	-0.260	0.799	0.009
Large bus	-0.193	0.343	-0.560	0.574	0.001
Trucks	0.101	0.162	0.620	0.535	0.003
Bicycle	0.031	0.069	0.460	0.648	0.022
Motorcycle	0.007	0.033	0.220	0.824	0.095
Tractor	0.009	0.118	0.070	0.941	0.008
Gas/electric stovetop	0.004	0.025	0.150	0.878	0.625
Gas/electric oven	-0.021	0.024	-0.860	0.391	0.248
Gas cylinder	0.017	0.028	0.610	0.541	0.769
Microwave	-0.052	0.058	-0.890	0.375	0.030
Vacuum cleaner	0.125	0.071	1.770	0.078	0.023
Blender/mixer	0.005	0.027	0.180	0.859	0.301
Refrigerator	0.042	0.028	1.490	0.137	0.419
Washing machine	-0.103***	0.028	-3.620	0.000	0.297
Electric iron	0.011	0.034	0.320	0.751	0.137
Electric water heater	0.093**	0.038	2.450	0.014	0.104

Solar panel	-0.008	0.027	-0.320	0.751	0.172
Solar water heater	0.060	0.094	0.640	0.522	0.010
Radio/cassette recorder/MP3 player	0.042	0.042	1.010	0.313	0.065
CD/DVD/VCD player	0.050	0.092	0.540	0.586	0.013
TV	-0.055	0.046	-1.200	0.230	0.539
Satellite dish	0.010	0.045	0.220	0.830	0.520
Smartphone	-0.006	0.023	-0.250	0.803	0.465
Tablet PC	0.078	0.061	1.290	0.199	0.030
Sewing machine	0.000	0.035	0.000	0.997	0.087
Electric generator	-0.025	0.037	-0.670	0.506	0.093
Electric fan	0.135***	0.025	5.360	0.000	0.286
Laptop/desktop computer	0.008	0.059	0.130	0.893	0.034
Boat	-0.075	0.125	-0.600	0.550	0.006
Metal/fibreglass water tank	-0.016	0.023	-0.690	0.490	0.343
Electric water pump	0.024	0.036	0.670	0.503	0.106
Books	0.009	0.037	0.230	0.816	0.080
Gold/silver jewellery	0.054**	0.024	2.240	0.025	0.242
Bank account	-0.011	0.096	-0.120	0.908	0.012
Sheep	0.000	0.023	0.000	0.999	0.354
Goat	-0.017	0.026	-0.650	0.517	0.198
Camels	-0.052	0.075	-0.690	0.488	0.016
Cows	0.009	0.045	0.190	0.850	0.052
Donkeys	-0.056	0.034	-1.640	0.102	0.097
Poultry	0.005	0.033	0.150	0.884	0.105
Bees	-0.053	0.065	-0.810	0.421	0.023
Age of HH head	0.001	0.001	1.100	0.272	44.7
Edu level of HH head: up to primary	-0.002	0.032	-0.060	0.951	0.160
Edu level of HH head: > primary up to secondary	0.021	0.031	0.670	0.502	0.231
Edu level of HH head: > secondary up to degree	0.069**	0.031	2.240	0.025	0.266
Edu level of HH head: degree and higher	0.063	0.038	1.650	0.100	0.110
Male-headed HH	-0.037	0.031	-1.200	0.231	0.866
HH currently displaced due to conflict	-0.007	0.025	-0.270	0.789	0.188
HH previously displaced, now returned	-0.200***	0.046	-4.330	0.000	0.057
Region: Hadramout	-0.288***	0.026	-11.190	0.000	0.407
Region: Janad	-0.005	0.038	-0.130	0.900	0.111
Region: Saba	0.113***	0.044	2.570	0.010	0.056
Constant	0.216***	0.045	4.810	0.000	
N	**864**				
F statistic	5.990				
R-squared	0.294				

Source: author's calculations.

Table 3: OLS regression coefficients of locust exposure on pre-2015 community characteristics

	Coeff.	Std. err.	t	P>t	Mean
Edu level of HH heads: up to primary	-0.071	0.488	-0.150	0.885	0.160
Edu level of HH heads: > primary up to secondary	0.130	0.445	0.290	0.772	0.231
Edu level of HH heads: > secondary up to degree	0.649	0.403	1.610	0.116	0.266
Edu level of HH heads: degree and higher	0.527	0.541	0.970	0.336	0.110
Share of male-headed HHs	0.103	0.553	0.190	0.853	0.866
Share of currently displaced HHs	-0.108	0.332	-0.330	0.746	0.188
Share of displaced but now returned HHs	-0.356	0.325	-1.100	0.280	0.057
Average HH pre-2015 asset index	0.019	0.021	0.900	0.373	0.425
Share of households owning agricultural land	0.081	0.226	0.360	0.721	0.318
Share of households owning non-agricultural land/ buildings	-0.024	0.244	-0.100	0.923	0.435
Adult literacy rate	-0.738*	0.420	-1.760	0.087	0.670
Adult sex ratio	-1.846*	0.998	-1.850	0.072	0.527
Region: Hadramout	-0.197	0.121	-1.630	0.111	0.407
Region: Janad	0.146	0.229	0.640	0.529	0.111
Region: Saba	0.014	0.199	0.070	0.946	0.056
Constant	1.353	0.756	1.790	0.082	
N	54				
F	1.450				
R-squared	0.3633				

Note: standard errors not clustered.

Source: author's calculations

I now examine the estimates of the coefficient β_1 from equation (2) using an OLS specification. The dependent variable is a dummy that takes the value of 1 for individuals who would like to migrate outside their communities and is 0 otherwise. A one standard-deviation increase in the measure of locust exposure increases the willingness to migrate by 11 percentage points overall, driven by rural areas where the increase is of the magnitude of 12 percentage points, over 40 per cent relative to the share of the rural population that is willing to migrate, i.e. 27.8 per cent. Table 4 shows that the magnitude of this effect does not change very much in response to the successive inclusion of controls in the estimation. For the remainder of this paper, I focus only on the rural sample, because of the clear link of the locust shock with rural livelihoods, and use the specification in column 5 of Table 5, which includes the full set of individual, household, and enumeration area-level controls and region dummies.

Table 4: Likelihood of Individual intention to migrate (1=individual intends to migrate)

	Total	Rural	Urban
L_j	0.109***	0.120**	0.058
	[0.032]	[0.052]	[0.049]
Controls	Yes	Yes	Yes
ymean	0.251	0.278	0.220
N	5,869	3,109	2,760

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls include: (individual) age, gender, educational attainment, marital status, employment status, (household) asset quintile, household size, dependency ratio, own dwelling, livestock ownership, displacement status, (community) mean household asset index at community level, community-level land ownership, community-level sex ratio, community-level adult literacy rate, soil moisture, soil sand content, mean temperature, urban/rural status, regional dummies.

Source: author's calculations.

Table 5: Likelihood of individual intention to migrate (rural only)

	(1)	(2)	(3)	(4)	(5)
Lj	0.145***	0.139***	0.120***	0.188***	0.120**
	[0.051]	[0.049]	[0.045]	[0.052]	[0.052]
Individual controls		Yes	Yes	Yes	Yes
Household controls			Yes	Yes	Yes
Community-level controls				Yes	Yes
Region dummies					Yes
R-squared	0.010	0.021	0.066	0.129	0.144
N	3,109	3,109	3,109	3,109	3,109

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as indicated in Table 4.

Source: author's calculations.

Disaggregating the analysis by demographic characteristics of the rural population shows that the effects are similar among men and women and do not bear any clear pattern by age group (Table 6). The effects, however, appear to be driven by those with the lowest levels of education, particularly those who are completely illiterate, suggesting their greater vulnerability to the locust shock. The effects also appear to be driven by those who either never experienced displacement or returned home following some duration of displacement, but not by those who are currently displaced.

Table 6: Likelihood of individual intention to migrate (rural only), by demographic characteristics

		Coeff. (Lj)	Std. err.	Y-mean	N
Gender	Female	0.115*	[0.062]	0.246	1,652
	Male	0.112**	[0.053]	0.314	1,457
Age	15–24	0.059	[0.057]	0.268	1,102
	25–44	0.141**	[0.068]	0.3	1,242
	45–64	0.083	[0.059]	0.272	562
	65+	0.629***	[0.163]	0.212	203
Level of education completed	No education	0.156**	[0.073]	0.235	884
	Up to primary	0.135	[0.094]	0.252	433
	Above primary up to secondary	0.056	[0.051]	0.289	858
	Secondary up to degree	0.032	[0.123]	0.311	726
	Degree and higher	0.094	[0.223]	0.328	192
Displacement status	Never displaced	0.140***	[0.051]	0.257	2,434
	Currently displaced	0.111	[0.088]	0.366	522
	Returned	1.107***	[0.223]	0.314	153

Source: author's calculations.

Men who are employed are much more strongly likely to seek to migrate in response to exposure to locust swarms than women or who are unemployed or outside the labour force (Table 7). Finally, those engaged in agricultural occupations, including livestock rearing, are much more strongly affected by locust exposure (Table 8). Locust exposure does not appear to have any significant effect on migration intentions among individuals and households that do not engage in agricultural occupations. This points to the potential salience of effects on mobility operating through livelihoods channels. I discuss this in more detail in the following section.

Table 7: Likelihood of individual intention to migrate (rural only) by labour force participation status, gender

	Male			Female		
	Outside labour force	Unemployed	Employed	Outside labour force	Unemployed	Employed
Lj	0.099	-0.224	0.217***	0.120*	0.058	0.220
	[0.060]	[0.148]	[0.066]	[0.061]	[0.181]	[0.242]
ymean	0.224	0.448	0.291	0.227	0.288	0.337
N	500	424	533	1,298	146	208

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as indicated in Table 4.

Source: author's calculations.

Table 8: Likelihood of individual intention to migrate (rural only) by livelihood characteristics

	Individuals engaged in agriculture		Anyone in HH engaged in agriculture		HH owns livestock	
	No	Yes	No	Yes	No	Yes
Lj	0.099**	0.366***	0.022	0.331***	0.059	0.137*
	[0.046]	[0.120]	[0.045]	[0.103]	[0.068]	[0.070]
ymean	0.277	0.288	0.292	0.263	0.322	0.257
N	2,786	323	1,583	1,526	1,004	2,105

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as indicated in Table 4.

Source: author's calculations.

6 Potential mechanisms

I explore four plausible pathways that may explain the effects of locust exposure on mobility intentions: the selective application of locust control operations, the selective targeting of post-locust aid, an economic shock to rural livelihoods, and the mediating effects of conflict. I examine these sequentially.

6.1 Selective locust control operations

Locust control operations, in the form of aerial or terrestrial spraying of pesticides, are critical for the control of locust outbreaks. However, these are effective only in the early stages of locust infestation, when the pests are in the nymph or hopper stage before they develop into voracious swarms. The effectiveness of control measures at that time is rather low. Furthermore, effective control requires continued surveillance and coordination with neighbouring countries as well as scientific and technical agencies that monitor locust activity for timely detection, especially around potential breeding grounds. In typical circumstances locust monitoring and control operations may be correlated with areas that are more accessible, of higher priority and of more importance to governments and bureaucrats. In such settings locust outbreaks may only occur in more marginalized areas that did not receive due prioritization for surveillance and control measures. In these cases the absence of sufficient control measures may simultaneously be correlated with higher government apathy and the eventual occurrence of locust swarms. The effects of locust swarms on mobility may therefore be confounded by the low prioritization and importance of affected areas accorded to them by administrators, which may directly drive the willingness to migrate among the population. However, this is unlikely to be the case in the current setting. As discussed in Section 2, the locust outbreak in 2019–21 developed against the backdrop of very

limited state capacity for surveillance and control operations due to the ongoing civil war, resulting in very few control measures. This is also evident in the fact that over 80 per cent of the population in the study area resided in districts with no control measures whatsoever. Selective locust control operations conflated with institutional prioritization of less affected areas is therefore unlikely to explain the results. As Table 9 shows, the results are robust to restricting the sample to districts with no locust control operations (accounting for most enumeration areas in the sample—columns 1–3), as well as controlling additionally for the number of locust control operations conducted in a district (columns 4–6).

Table 9: Likelihood of individual intention to migrate, by locust control operations (LCOs) in the district

	Districts with no locust control operations			Full sample		
	Total	Rural	Urban	Total	Rural	Urban
	(1)	(2)	(3)	(4)	(5)	(6)
inz_min_swdist21	0.120***	0.153**	0.032	0.109***	0.136**	0.072
	[0.037]	[0.070]	[0.067]	[0.034]	[0.056]	[0.052]
ymean	0.266	0.294	0.234	0.251	0.278	0.220
Controlling for number of LCOs @ district	-	-	-	Yes	Yes	Yes
N	4,426	2,347	2,079	5,869	3,109	2,760

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as indicated in Table 4.

Source: author's calculations.

6.2 Selective targeting of post-locust aid

Is the effect of locust exposure on the willingness to migrate driven by the subsequent rollout of assistance in locust-affected communities, which may have in fact spurred migration intentions? A vast literature has explored the links between receipts of cash and other assistance and human mobility (see Adhikari and Gentilini 2018 for an overview), positing that cash transfers that do not entail continued residency requirements can encourage migration by helping liquidity-strapped households to meet the costs of migrating. Unconditional cash transfers can increase the ability to migrate by relaxing liquidity constraints. Although this paper focuses on the *willingness* to migrate, interventions such as cash transfers that enhance the *ability* to migrate may indirectly encourage recipients to seek to migrate by relaxing a critical constraint. If cash transfers are correlated with locust exposure, specifically if they are directed to compensate households affected by locust swarms, the effects of cash transfers on migration may be wrongly attributed to locust exposure. However, this is not likely to be the case in this setting for multiple reasons. First, as described in Section 2, despite burgeoning needs, humanitarian assistance for Yemen has routinely fallen short of requirements since the conflict. The near collapse of most state-led cash transfer and social protection programmes during the conflict (Ghorpade and Ammar 2021) and the limited scale of assistance provided specifically to locust-affected households also makes an infusion of cash transfers an unlikely explanation for the observed effects on mobility. Secondly, as Table 10 shows, the effects are driven by non-recipients of cash and in-kind assistance.[6] This finding is in line with Paul (2005), who argues that the receipt of assistance prevented households from migrating following a cyclone in Bangladesh. Shock-induced migration may therefore be offset, rather than exacerbated, by the timely extension of cash assistance. Taken together these findings negate the

[6] Excluding in-kind food transfers where receipts do not appear to mediate effects.

hypothesis that post-locust aid, rather than locust exposure itself, may have driven the higher willingness to migrate.

Table 10: Likelihood of individual intention to migrate (rural only) by the receipt of assistance

	Received cash assistance		Received food assistance		Received other in-kind assistance	
	No	Yes	No	Yes	No	Yes
Lj	0.110**	0.033	0.099	0.155	0.126**	0.149
	[0.054]	[0.186]	[0.059]	[0.101]	[0.052]	[0.303]
ymean	0.291	0.229	0.298	0.235	0.282	0.204
N	2,471	638	2,130	979	2,952	157

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as indicated in Table 4.

Source: author's calculations.

6.3 Conflict-induced migration intentions

Is the increased willingness to migrate due to locust exposure confounded by conflict incidence? In other words has an exacerbation of conflict due to the locusts resulted in a greater desire to migrate to escape conflict, which may be incorrectly attributed to locust exposure? Biscaye (2024) finds that locust exposure is associated with an intensification of conflict, mainly by reducing the opportunity cost of fighting. Although the estimates presented so far control for conflict exposure (through the number of conflict-related fatalities in a 25-km radius of each enumeration area), I separately examine the interaction of locust and conflict exposure. Column 2 of Table 11 shows that conflict may have dampened rather than driven the effect of locust exposure on migration intentions. The pure effect of locust exposure after controlling for and interacting locust exposure with conflict exposure is now much stronger and, while conflict intensity reduces the positive effect of locust exposure on migration, the average effect remains positive. This negates a hypothesis of conflict driving migration intentions that may be wrongly attributed to locust exposure.

Table 11: Individual willingness to migrate in response to locusts and conflict exposure

	(1)	(2)
Lj	0.120**	0.171***
	(0.052)	(0.061)
Fatalities in conflict ('000)	-0.041***	0.015
	(0.000)	(0.041)
Lj* Fatalities in conflict ('000)		-0.245
		(0.167)
ymean	0.278	0.278
N	3,109	3,109

Note: standard errors in brackets; clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as indicated in Table 4.

Source: author's calculations.

6.4 Economic shock

The economic shock channel postulates that exposure to a shock such as the locust swarm outbreak could depress rural, especially agricultural, outputs and wages. Diminished economic prospects as a result of these effects may increase the appeal of migration as a way to compensate income losses suffered due to the shock. As discussed earlier, the effects of locust exposure on migration intentions are driven primarily by uneducated and economically active men, especially in agriculture and livestock-related occupations. These point to the potential salience of the livelihood loss-based explanation. Exposure to locust swarms is indeed associated with lower levels of individual earnings (Table 12) and household welfare (measured by consumption expenditure, Table 13). Although there are no significant effects of the locust shock on the welfare indicators of the economy as a whole, I find strong evidence of a negative effect of locust exposure on these measures of economic wellbeing among agricultural households and individuals, and particularly among livestock-owning households. This suggests that locust exposure caused considerable but localized earnings losses through the destruction of crops, but also through reductions in livestock income, potentially through the reduced availability of grazing areas due to locust attacks. These results are in line with studies that found persistent effects of locus swarms on agricultural surpluses and household wellbeing (Biscaye 2024; Marending and Tripodi 2022).

Table 12: Monthly individual income in YER: Tobit estimates

	Total rural	Sector of employment		HH livestock ownership	
		Non-agricultural	Agricultural	No	Yes
Lj	-68,396***	-71,597***	-123,638**	-49,708	-109,961***
	(22163)	(24007)	(55031)	(39586)	(29189)
ymean	18264	15015	46285	20411	17240
N	3,109	2,786	323	1,004	2,105

Note: standard errors in parentheses, clustered at the enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Income distribution left censored at zero to account for selection into paid employment; controls as described in Table 4.

Source: author's calculations.

Table 13: Household monthly consumption expenditure in YER (temporally and spatially deflated)

	Total rural	Non-agricultural household	Agricultural household	HH livestock ownership	
				No	Yes
Lj	-19,483	10,957	-100,899*	25,963	-92,109**
	(40678)	(62135)	(52212)	(40212)	(40497)
ymean	304,745	298,959	311,762	294,474	310,798
Coeff/ Ymean	-6%	4%	-32%	9%	-30%
N	863	473	390	320	543

Note: standard errors in parentheses, clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as described in Table 4 and include household size. An agricultural household is defined as one with any member involved in agricultural activities or owning agricultural land.

Source: author's calculations

Table 14 shows that the effects of locust exposure on migration intentions are driven by those whose economic situation is worse compared to one year before the survey (in 2021) and since the beginning of the conflict in 2015. Taken together these findings underscore the heavy and persistent negative effects of the locust exposure on household and individual wellbeing, which in turn appears to drive a higher willingness to migrate. This provides evidence in favour of the

economic hardship inflicted by a natural disaster on rural and agriculture-dependent communities underlying the increased willingness to migrate, potentially in search of better economic opportunities.

Table 14: Individual willingness to migrate, by subjective assessment of present economic situation compared to the past

	Compared to 1 year ago		Compared to before the conflict (6 years)	
	Same/better	Worse	Same/better	Worse
Lj	0.163	0.102*	0.367	0.131**
	(0.188)	(0.053)	(0.219)	(0.065)
ymean	0.236	0.286	0.235	0.293
N	501	2,608	818	2,291

Note: standard errors in parentheses, clustered at enumeration area level. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$. Controls as described in Table 4.

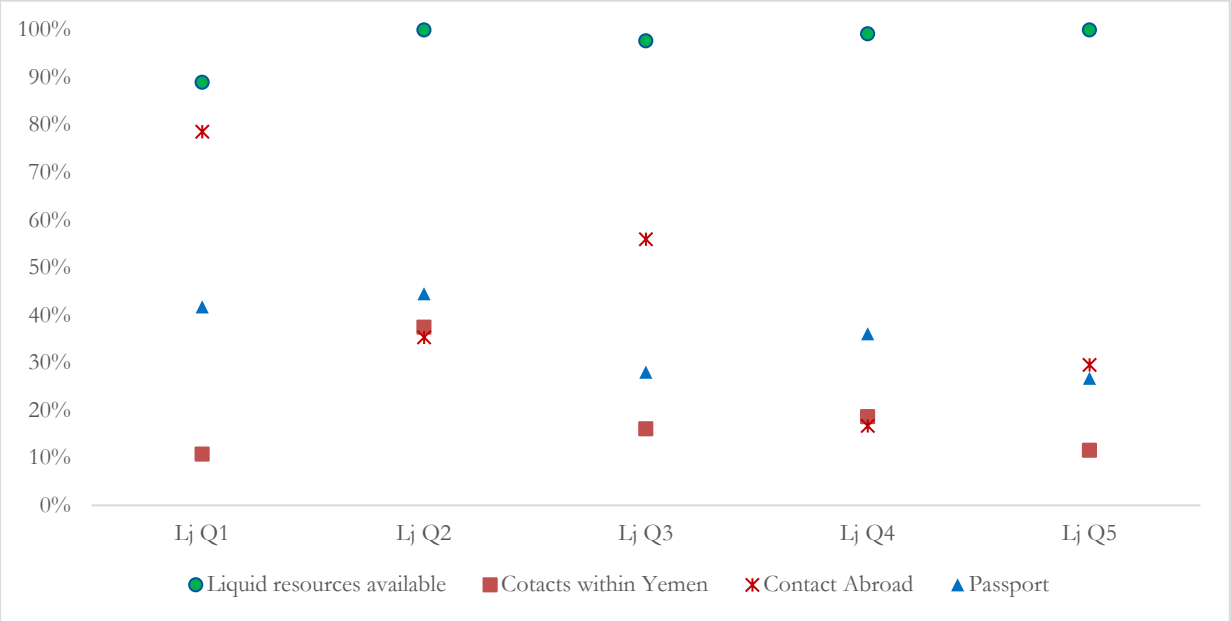
Source: author's calculations

7 Implications

How well prepared to migrate are those whose willingness to migrate is attributable to locust exposure? I undertake a brief exercise to identify which type of individuals' willingness to migrate is most responsive to locust exposure, and then assess their potential level of preparedness to actually undertake migration. A growing literature on environmental migration and displacement has pointed out that, while large populations may be under duress to relocate in response to climate change and environmental factors, these pressures may not always translate into actual movements because of the inability of people to move. This has given much credence to the concept of immobility (Zickgraf 2018), where large numbers of people who may be willing but unable to move remain 'trapped' in areas of greater climate and environmental vulnerability.

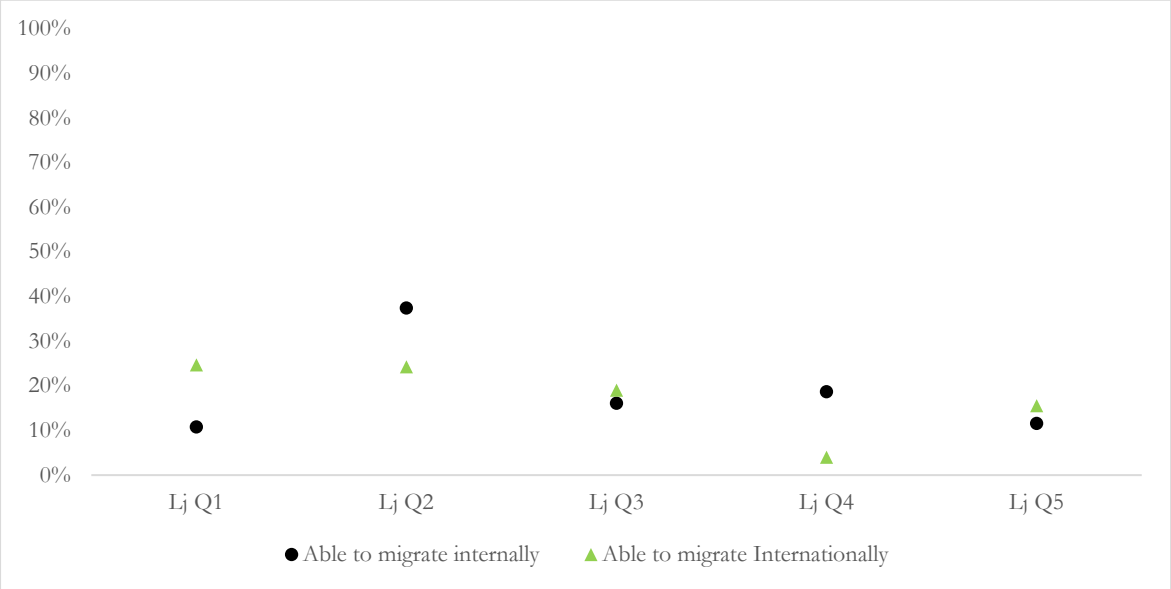
I measure the ability to move, internally or internationally, based on an individual's access to two key resources: 1) social networks or contacts and 2) resources to finance the move. In the case of an international relocation, possession of a valid passport is an additional administrative requirement. Based on these requirements for undertaking a move, I assess the ability of individuals to undertake internal and international migration across quintiles of Lj, the indicator of locust exposure (Figures 4 and 5). I define the ability to migrate internationally by simultaneous access to liquid resources (precautionary savings, receipt of remittances, receipt of cash transfers, or the self-assessed ability to obtain a loan if needed), social networks (contacts abroad who can help the individual find a job), and a valid passport. In the case of internal migration, I relax the requirement for having a passport and proxy the access to social networks through the receipt of remittances originating within Yemen, or by any member of the household having migrated outside in the last six years. This is a very conservative measure of the ability to migrate as several other factors that determine eventual migration outcomes, such as obtaining visas, being able to undertake the journey, or social contacts coming through on their ability to help secure jobs, are not observed. The estimates may therefore be thought of as a generous upper-bound estimate of eventual migration flows.

Figure 4: Enablers of migration, by quintiles of locust exposure



Source: author's calculations.

Figure 5: Share of those able to migrate among those able to, by quintiles of locust exposure



Source: author's calculations

Taken together these factors suggest that most individuals who were willing to migrate and were most exposed to locust swarms might not actually be able to migrate, either internally or internationally. They appear to be most constrained by social networks necessary for migrating. Even under very generous assumptions of the ability to migrate, in the areas most exposed to locust swarms, less than a fifth of those who seek to migrate may in fact be able to. They are more likely to remain trapped in their communities, underlining the need to support people affected by natural disasters in situ and the limits of migration as a likely coping strategy in response to shocks, despite its desirability.

8 Robustness tests

Do the results underestimate the extent of migration intentions due to the out-migration of people between the timing of locust swarms and the survey? To the extent that entire families may have migrated out of their areas of residence, one may not be able to observe them. However, this is not likely to be a major occurrence because the time between the locust crisis and the survey coincides with the COVID-19 pandemic and the enforcement of lockdown measures in the destination countries for Yemeni emigrants, namely Saudi Arabia and other Gulf Cooperation Council countries. To the extent that families may have migrated to other locations within southern Yemen, the survey being representative of all of southern Yemen would have included them at destination. The only group of households that is systematically likely to be missed is those that may have migrated from southern to northern Yemen, which again is rather unlikely. Moreover, the estimates can then be thought of being the lower bound for locust-induced migration. The results are robust to restricting the sample to only those households where no member changed their location of residence between the onset of the conflict in 2015 and the survey in 2021 (representing 84.5 per cent of households in the population). Table 15 summarizes the main findings of a series of other robustness and placebo tests. The main results are robust to these multiple tests.

Table 15: Summary of robustness tests

	Main result	Main source of heterogeneity	Plausible mechanisms		
	Total/ rural/ urban	Ag/ non-ag livelihoods	Conflict	Targeting of aid	Economic shock
A1. Full sample (rural + urban)	√	√	√	√	√
Alternate measures of locust exposure					
A2. Count of locust swarms in 30-km radius	√	√	X	√	√
A3. Average distance to nearest 3 swarms	√	√	√	√	√
A4. Average distance to nearest 5 swarms	√	√	√	√	√
A5. Average distance to nearest 10 swarms	√	√	√	√	X
Falsification tests					
A6. Restricting sample to non-movers	√	√	√	√	√
A7. Restricting sample to sub-districts with no locust control operations	√	√	√	√	√
A8. Controlling for no. of locust control operations in the sub-district	√	√	√	√	√
IV Estimation					
A9. Soil sand content, soil moisture and temperature as IV (quadratic specification)	√	√	√	√	√
Placebo test					
A10. Restricting sample to non-agricultural rural households	X	-	X	X	X

Note: √ results robust (direction and significance). X results do not hold.

Source: author's calculations.

9 Conclusion

This paper studied the effect of the 2019–21 desert locust outbreak on the intention to migrate among rural households and individuals in Yemen as an illustration of the human mobility impacts of climate change-related shocks in a complex emergency setting. Using the first representative household survey conducted in southern Yemen since the beginning of the ongoing conflict, I find that a one standard-deviation increase in exposure to desert locusts increases the individual willingness to migrate (internally or abroad) by 12 percentage points among rural residents. The effects are driven by agricultural households, plausibly due to the income shock experienced by them as a result of locust exposure. I rule out alternate explanations offered by the selective targeting of aid, selective locust control operations, or by the exacerbation of underlying conflict, and argue that the findings are consistent with distress migration following an economic shock. While exposure to locust swarms increases the willingness to migrate in low-conflict areas, it deters migration intentions in high-conflict areas, underlining the role of conflict and safety perceptions in mediating responses to the locust plague. Finally, despite an increase in the willingness to migrate following locust outbreak shocks, very few people may actually be able to undertake migration, mainly because of the lack of access to necessary social networks. As migration intentions may not be realized, the majority of the affected population may instead be 'trapped'—willing but unable to migrate in response to a formidable natural disaster.

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