

## Using longitudinal disaggregated data to unravel the patterns of (im)mobility in a drought-prone area of Ethiopia

Recent systematization of the literature reviews points out that despite increasing research efforts, empirical evidence on the proportional impacts of a changing climate on human mobility is scant (Hoffmann et al. 2020; van der Land et al. 2018; Hunter et al. 2015) and currently thin on quantitative assessment (Thalheimer et al. 2021; Abel et al. 2019; Cattaneo et al. 2019; Groth et al. 2020). In a study of more than 1,190 scientific papers and 463 empirical studies of environmental migration, Pigué et al. (2018) reveal that the realities of many people may not be taken into account in the current research field of environmentally-induced migration simply because they do not live in geographies that are often scrutinized or, when the areas are studied, most of the researchers use their own primary data with samples and collection methods not always explicitly being stated (Borderon et al. 2019), impacting the necessary transparency to understand whose realities counts. As Otto et al. (2020) and Thalheimer et al. (2021) pointed out for the region of East Africa, comprehensive evidence is still missing for places vulnerable to a changing climate and potential hotspots of increasing hazards.

If only a few large sample studies have examined the evolution and transformation of migration systems under changing environmental conditions, this may be due to the difficulties involved in capturing the dynamic component of both dimensions – the human mobility and the environmental conditions -, as well as their interaction and other key relevant factors involved in the migration-decision process (see Fussell et al. (2014) for a general review on demographic data and methods appropriate for studying environment–migration associations and Borderon et al. (2019) for a more specific characterisation of the migration and environmental components used in empirical case studies related to Africa). Data on internal migration remains spatially and temporally patchy (Hoffmann et al. 2020), which is problematic since internal, rather than international, migration is by far the more relevant form of mobility in the context of environmental change (Cundill et al. 2021; Rigaud et al. 2018).

The quality and quantity of empirical evidence would then depend on increased collection of quantitative data to be used in the field of population-environment research (Bilsborrow and Henry 2012; Pigué 2010). While *new* data can therefore be collected in this sense, it is also important to reflect on *existing* data, whose potential for studying the link between migration and the environment has not yet been fully tapped and could greatly contribute to the interdisciplinary effort of addressing the spatial and temporal dynamics of the migration-environment nexus.

With this goal of a more systematic use of existing secondary data as our focus, we have explored the literature and demographic data platforms that can provide measures of migration and its contextual- and individual-level drivers. One data source in particular caught our attention: the intensive longitudinal data collection from [Health and Demographic Surveillance Systems \(HDSS\)](#). We have taken a closer look at their data usage in the case of migration studies and discuss the possibility of exploiting the data in the context of environmental change.

## **The Health and Demographic Surveillance Systems to study internal migration**

The Health and Demographic Surveillance Systems (HDSS) INDEPTH Network (<http://www.indepth-network.org>) routinely collects information on demographic (including migration-) and health-related data from 3.8 million people in 49 field sites in 19 countries in Sub-Saharan Africa, as well as South and Southeast Asia. A typical HDSS site has a contiguous demographic surveillance area of several hundred square kilometres, with ~80,000 people under surveillance, in ~12,000 households, and is visited two or three times a year. Most of the HDSS sites have already been operating for 10 to 20 years. However, some are much older (HDSS Matlab in Bangladesh, and Niakhar in Senegal, both started in the 1960s).

The topic of migration has not yet been extensively addressed in the studies on HDSS data (Bocquier 2016). To our knowledge, worldwide there is mainly one HDSS (HDSS Agincourt in South Africa) which has been actively used in the research of migration-related issues (Collinson 2010; Myroniuk et al. 2018). The team involved in the migration-related studies has also been the first to use data from different HDSS to unravel the nexus between health and migration (Gerritsen et al. 2013; Ginsburg et al. 2016a; Ginsburg et al. 2016b). In HDSS Agincourt, the research team from Boulder, Colorado, has been the first to address the nexus of migration and environment with such data (Hunter et al. 2017; Leyk et al. 2012; Hunter et al. 2014) and continue to do so (Hunter et al. (2021) use the Agincourt HDSS data to offer an example on how to link people and places while balancing research and privacy needs). Since then, few other studies using HDSS data in the context of mobility and environmental change have followed (Call et al. (2017) with the data from Matlab, Bangladesh and Lalou and Delaunay (2017) with the HDSS data from Niakhar, Senegal). Sporadically, a few other HDSS sites have published research including the migration dimension (in Nairobi, Kenya, about migration patterns in slum settlements (Beguy et al. 2010); in Matlab, Bangladesh, on outmigration from the site (Alam and Barkat-e-Khuda 2011); in HDSS, Tanzania, about gender and youth migration (Todd et al. 2017).

Considering the tremendous benefits that panel data can have in the search for robust empirical evidence on the proportional impacts of a changing climate on human mobility (Geography Directions 2021), it is surprising that these data remain under-exploited. Without speculating on their perfection and aware of the interests and limitations - some of which have already been well-documented in the literature (Ekström et al. 2016; Bocquier et al. 2017; Ginsburg et al. 2018; Sankoh 2017) - they seem to us to have the advantage of offering a fairly unique vision of population mobility through a wealth of data in three dimensions: a large number of individuals, a decent number of variables and multiple time intervals. What a privilege to think that a contextual analysis of the relationship between migration and environmental change when set against larger social, economic and gender settings can be carried out! The so-far limited use of HDSS data might be due to two factors: a) the INDEPTH Network makes the data available online only to a very limited extent, i.e. access to the raw data requires direct personal contact with the Surveillance Centres, and b) the preparation and analysis of the data for migration-related questions is associated with necessary expertise in terms of content, methodology and technology, which requires an initial major investment with regard to time and skill development.

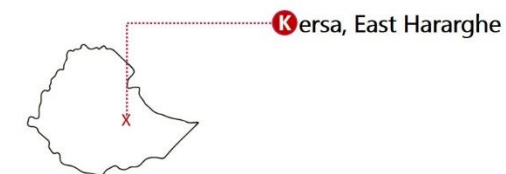
### **A case study in Kersa, Oromia Region, Ethiopia**

Drawing on a close cooperation with the Kersa Demographic Surveillance and Health Research Center ([KDS-HRC](#)), Oromia region, Eastern Ethiopia, we have been investigating the population mobility patterns of this deprived rural area of East Hararghe. The KDS-HRC has collected data since 2007 and currently represents about 148,000 individuals in 24,000 households under investigation (Assefa et al. 2016). Originally, the site covered 12 kebeles and since 2014, the site has doubled in size: 12 kebeles have been added to the initial 12 ones (as the entire population of each kebele is investigated, the data collection is not based on population sampling).

We are currently examining who engages in migration processes and which segments of the population seem to be less mobile in the 12 kebeles where we have data since 2007. The operational definition of an out-migration followed by the Kersa HDSS corresponds to “the movement of a person or group of people from their usual residence for more than 6 months”. Following a multilevel approach, we are investigating how individual and household capabilities, perceptions on living conditions and social and environmental conditions shape the propensity of individuals to migrate, where and for which motives. The spatio-temporal dimension of the data, over ten years of observation and characterising five different types of environment (urban with two small cities, rural lowland, rural midland with irrigation, rural midland without irrigation and rural highland), makes it possible to offer a rare description of the question at a fine scale. See figure. 1 as an example that summarizes some of the multiple and intersecting characteristics of mobility in the Kersa region.

**Fig 1. The changes of migration profile after the extreme drought event of 2015**








The **individual**, **household** & **community** characteristics of mobility in 2015 & 2016 in comparison with the other observable years (2007-2014)



The results marked in blue (dark blue when the value is higher than the total average, light blue when the value is lower than the total average) highlight notable changes in the nature of migration during the drought of 2015 and one year after, compared to previous years. The table reads as follows:

On average, 52.3% of the migrants observed in Kersa are from the poorest households. In the post-drought year, this proportion is higher, reaching 60.8%, while the richest households represent only 10.8% (compared to an average of 14.8% in other years).

\*The household poverty index describes the assets and housing conditions of the household. It results from a Multiple Factor Analysis (MFA) made of 17 variables : the source of drinking water, the location of the source of drinking water, the type of the toilet facilities, the occupation of the head of the household, having own income, owning land, owning animals (this variable is a cumulative weighted index of 9 subvariables), owning equipments (i.e. having electricity, bed, chair, table, television, ...) this variable is a cumulative weighted index of 14 subvariables), owning goods for communication and transportation (i.e mobile phone, bicycle, car, ...) (this variable is a cumulative weighted index of 7 subvariables), the type of fuel to be used for cooking, the general condition of the house, the type of floor, the type of roof, the material of the wall, having windows in the house, having rooms used only for sleeping, having an account with a bank/credit association/micro finance).

		Other years without rainfall deficit (2007-2014) (N=9078)	Extreme drought event (2015) (N=1358)	Post drought (2016) (N=1351)	Total (N=11787)
	<b>Sex</b>				
	Female	5615 (61.9%)	827 (60.9%)	<b>890 (65.9%)</b>	7332 (62.2%)
	Male	3463 (38.1%)	531 (39.1%)	<b>461 (34.1%)</b>	4455 (37.8%)
	<b>Literacy</b>				
	Literate	5385 (59.3%)	<b>942 (69.4%)</b>	<b>947 (70.1%)</b>	7274 (61.7%)
	Illiterate	3693 (40.7%)	<b>416 (30.6%)</b>	<b>404 (29.9%)</b>	4513 (38.3%)
	<b>Occupation</b>				
	Primary sector	1751 (20.1%)	287 (22.5%)	289 (21.6%)	2327 (20.5%)
	Secondary and tertiary sectors	4232 (48.5%)	659 (51.6%)	657 (49.2%)	5548 (49.0%)
	Dependent population & unemployed workers	2734 (31.4%)	<b>331 (25.9%)</b>	390 (29.2%)	3455 (30.5%)
	NA	361	81	<b>15</b>	457
	<b>Migration destination</b>				
	Within the woreda	5979 (67.0%)	810 (60.1%)	<b>1090 (84.1%)</b>	7879 (68.1%)
	Within Ethiopia	2806 (31.4%)	<b>497 (36.9%)</b>	<b>197 (15.2%)</b>	3500 (30.3%)
	International	140 (1.6%)	<b>41 (3.0%)</b>	<b>9 (0.7%)</b>	190 (1.6%)
	NA	153	10	55	218
	<b>Reasons for migration</b>				
	Marriage	3041 (33.8%)	466 (34.3%)	522 (38.6%)	4029 (34.4%)
	Work	2459 (27.4%)	394 (29.0%)	<b>337 (24.9%)</b>	3190 (27.3%)
	Searching for land	1350 (15.0%)	<b>74 (5.4%)</b>	<b>64 (4.7%)</b>	1488 (12.7%)
	Others	2228 (23.8%)	424 (31.3%)	428 (31.8%)	2989 (25.6%)
	NA	91	0	0	91
	<b>Household poverty index*</b>				
	High	4552 (50.4%)	<b>765 (56.5%)</b>	<b>820 (60.8%)</b>	<b>6137 (52.3%)</b>
	Medium	3012 (33.4%)	<b>459 (33.9%)</b>	<b>382 (28.3%)</b>	3853 (32.9%)
	Low	1461 (16.2%)	<b>130 (9.6%)</b>	<b>146 (10.8%)</b>	1737 (14.8%)
	NA	53	4	3	60
	<b>Environmental settings</b>				
	Lowland	969 (10.7%)	<b>129 (9.5%)</b>	<b>197 (14.6%)</b>	1295 (11.0%)
	Midland	2685 (29.6%)	<b>443 (32.6%)</b>	<b>352 (26.1%)</b>	3480 (29.5%)
	Midland with irrigation system	1518 (16.7%)	<b>215 (15.8%)</b>	<b>272 (20.1%)</b>	2005 (17.0%)
	Highland	1209 (13.3%)	<b>236 (17.4%)</b>	<b>209 (15.5%)</b>	1654 (14.0%)
	Urban	2697 (29.7%)	<b>335 (24.7%)</b>	<b>321 (23.8%)</b>	3353 (28.4%)

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