MEASURING SUBNATIONAL RESILIENCE IN LOW- AND MIDDLE-INCOME COUNTRIES

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OBJECTIVE

This poster presents a subnational index applying the U.S. Census Bureau's Community Resilience Estimates to an international setting (I-CRE) to measure social resilience to environmental hazards.

WHAT IS CRE?

Community Resilience Estimates (CRE) is a method developed by the U.S. Census Bureau to provide an easily understood metric for how at-risk neighborhoods in the United States are to the impacts of disasters, including COVID-19 (Sawyer et al., 2022). Unlike other indexes, CRE uses micro level data to calculate ten possible risk factors and estimate the number and percentage of people in a specified community who have low, medium, and high levels of risk (Bradatan et al., 2023). A household is considered to have: 1. Low risk, if they have 0 risk factors; 2. Medium risk, if they have 1–2 risk factors; 3. High risk, if they have 3 or more risk factors.

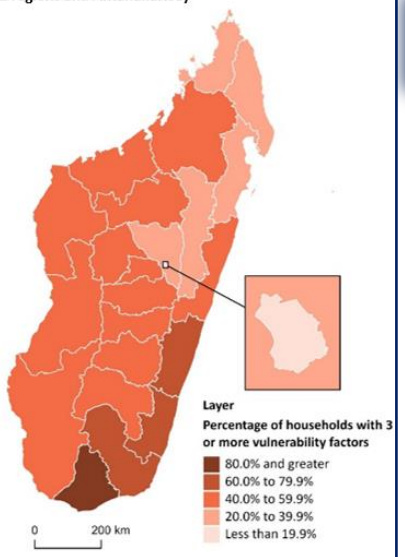
This study expands the U.S. Census Bureau Community Resilience Estimates method to the international level (I-CRE). It introduces a community resilience measure that can be estimated at the subnational level for countries with limited data available using IPUMS data or DHS (Demographic Health Surveys) data. The DHS factors used are in Table 1.

Table 1. Community Resilience Estimates factors for Low and Middle-Income Countries using DHS data.

Risk Factor (RF) (all at the household level)	Definition
RF1	Low wealth index
RF2	Single or zero caregiver household (only one or no individuals living in the household who are 18-60).
RF3	Unit-level crowding, defined as more than 3 persons per room.
RF4	Communication barrier, defined as the lack of anyone in the household over the age of 16 who has completed primary school.
RF6	Households without a vehicle (bicycle, scooter, car)
RF7	Households without a cell phone or landline phone
R10	Number of people age 60+ in the household

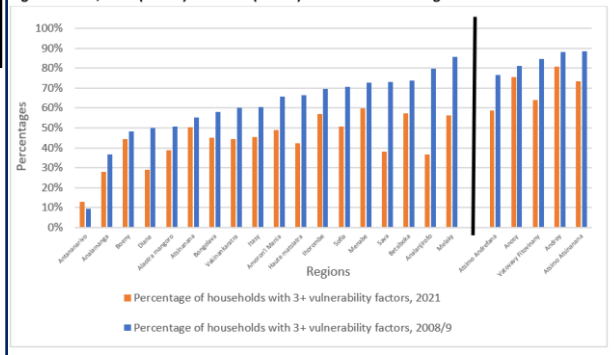
Note: All risk factors are at the household level
Source: U.S. Census Bureau, 2024.

Figure 1. International Community Resilience Estimates for Madagascar (CRE21 mapped at the region (ADM1) level (22 regions and Antananarivo)



Source: U.S. Census Bureau, 2024.

Figure 2. ICRE, 2008 (CRE08) and 2021 (CRE21) for each of the 22 regions and Antananarivo



Note: The five rightmost regions have consistently low resilience on 2008/09 & 2021
Source: U.S. Census Bureau, 2024.

CASE STUDY: MADAGASCAR

The IPCC Sixth Assessment Report (2023) estimates that Southern Africa will face agricultural droughts as climate change effects become more prevalent. In 2021, more than one million people in Madagascar struggled to get enough food due to a prolonged drought (UN, 2021). Regardless of whether the extreme weather conditions between 2019-2021 are the result of climate change, those conditions affected the wellbeing of people in southern Madagascar, a region where up to 80% of people rely on small-scale and mostly rain-fed agriculture (World Food Program, 2022). Given the inequalities existing in Madagascar, we first created a CRE21 for Madagascar shown in Figure 2. Then, we analyze how important social factors have been in shaping this food crisis by looking at the dependent variables change and rate of change between CRE08 and CRE21 for Madagascar at an ADM1 level. Equations are below.

$$CHANGE_{08\_21} = CRE08 - CRE21$$

The higher CHANGE08_21, the more community resilience has improved in that region.

$$RATE_{08\_21} = \frac{CRE08 - CRE21}{CRE08}$$

The higher RATE08_21, the faster the rate of improvement in community resilience in that region.

METHODS

For this case study, we calculated the Community Resilience Estimates at the ADM1 (regions) level for 2008/09 (CRE08) and 2021 (CRE21) using DHS data for those years**. Low resilience in both CRE08 & CRE21 is defined as the percentage of households in the region with 3 or more vulnerability factors. Higher CRE means more vulnerability.** The number of factors (3) to signify "high risk" was decided by the U.S. Census Bureau based on U.S. distribution of household risk factors but can be different for other countries. We used the open-source statistical programming language R with library {questionr}' to calculate CRE08 and CRE21.

Table 2. Regression Analysis Introducing International Community Resilience Estimates (CRE08) as a Controlling Factor.

	Model 1 (without controlling for CRE08)				Model 2 (controlling for CRE08)			
Dependent	Predictors	Coeff.	Std. Error	Adj. R^2	Predictors	Coeff.	Std. Error	Adj. R^2
CHANGE08_21	DROUGHT	-0.10	0.07	0.05	DROUGHT	-0.21**	0.07	0.33
					CRE08	0.47**	0.15	
RATE08_21	DROUGHT	-0.20	0.12	0.07	DROUGHT	-0.35*	0.13	0.21
					CRE08	0.65*	0.30	

Source: U.S. Census Bureau, 2024.

RESULTS & ANALYSIS

CRE21 results are shown in Figure 1. Three of the regions affected (Androy, Anosy, Atsimo Atsinanana) had low community resilience (high CRE) both in 2008 and 2021 as seen in Figure 2. Table 2 shows that when CRE08 is introduced as a controlling factor, being in the drought area becomes a significant factor for both CHANGE08_21 ($p<0.01$) and RATE08_21 ($p<0.05$) and CRE08 is significant as well. Our analyses suggest that historically low levels of community resilience in the regions affected can be a reason why the effects of this slow onset hazard are so impactful. This cursory analysis goes to show that among many other factors, community resilience should be taken into account when analyzing impacts of environmental hazards.

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Note: Throughout all processes associated with reporting results, unauthorized release of protected information or administratively restricted information must be prevented by following federal laws (e.g., Title 13, Title 15, and Title 26) and Census Bureau policies. Data used come from sources outside of the U.S. Census Bureau and are subject to errors coming from a variety of sources such as sampling error, non-sampling error, model error, as well as any other sources of error. Microlevel data are publicly available and can be downloaded from https://dhsprogram.com/Data/ after registering with the DHS program. More information on confidentiality protection, methodology, sampling and non-sampling error, and definitions can be found at https://dhsprogram.com/Methodology/index.cfm