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DATA 150 Evolving Solutions

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Annotated Bibliography - Housing as it Relates to Human Development Indicators

1. Brown, Sandra. "Spatial Analysis of Socioeconomic Issues: Gender and GIS in Nepal." *Mountain Research and Development, 23(4) : 338-344*, International Mountain Society, Nov. 2003, https://bioone.org/journals/mountain-research-and-development/volume-23/issue-4/0276-4741(2003)023[0338:SAOSIG]2.0.CO;2/Spatial-Analysis-of-Socioeconomic-Issues--Gender-and-GIS-in/10.1659/0276-4741(2003)023[0338:SAOSIG]2.0.CO;2.pdf.

Sandra Brown explores the economic wellbeing of women in Nepal by analyzing socioeconomic indicators through geospatial data. Her findings explore the relationship between geospatial indicators and cultural norms in a subsistence farming family in Nepal. The study evaluates several data classes including elevation classes, aspects classes— "dominantly south-facing, hotter, drier, with road access, and dominantly north-facing, cooler, more moist, with poor access"—and land use classes. Her study provides information related to the 2030 United Nations Sustainable Development Goals of gender equality, no poverty, and decent work and economic growth. To collect this data, Brown conducted a gender-disaggregated

resource-use survey across 337 sites as well as a short questionnaire summarizing management dynamics and conditions on the site.

Brown hypothesizes that the socioeconomic factors in subsistence farming households play a role in analyzing constraints on resource management, and therefore domestic gender roles. These socioeconomic indicators influence the economic development of the female population in Nepal because the gender roles within a household are precursors to individual freedom. For example, women in houses near the road share greater responsibility in resource management, indicating a higher level of education. In Nepal, where illiteracy inhibits a woman's ability to extend agricultural influence and engage in the use of new technologies, the Nepalese government encourages the education of young women. Education represents social freedom as well as economic freedom and indicates high levels of human development in the realms of gender inequality.

Although the data shows a clear correlation between economic wellbeing and an increased level of education for women, Brown explores the possibility of reverse causality in her study; affluent families facilitate access to education. Land ownership and total crop returns correlate with economic well-being and decision-making roles for female members of a household. In the short questionnaire, men and women in Nepal describe the allocation of labor by gender. Overwhelmingly, women tend to the livestock and household care while men have the most influence over farm management. Women, on average, work 3.8 hours longer than men each day. Brown seeks to ameliorate this imbalance in the labor efforts between men and women by identifying the geospatial indicators of gender inequality in relation to socioeconomic development.

Within this data set, Brown discovered that women living near roads in Nepal spend 85% of their day working and have greater shared responsibility, while women living far from roads spend 79% of their day working and have less shared responsibility. Brown draws the connection between economic opportunity and cultural norms in Nepal. Attitudes surrounding resource management and shared responsibility shifted between the unique data classes, and Brown asserts that cultural norms play the largest role in land type and usage, and therefore the condition of the site indicates the level of gender equality in domestic dynamics within a subsistence farming household.

2. Tusting, Lucy S., et al. "Housing Improvements and Malaria Risk in Sub-Saharan Africa: A Multi-Country Analysis of Survey Data." *PLOS Medicine*, Public Library of Science, 21 Feb. 2017, journals.plos.org/plosmedicine/article?id=10.1371/journal.pmed.1002234.

Lucy S. Tusting and her team explore the relationship between quality housing and the spread of malaria in Sub-Saharan Africa by analyzing types of material and the presence of malaria-prevention additions in the home. Her team collected data from housing material of three classes, "natural," "rudimentary," and "finished," and houses of two classes, "traditional," and "modern." An example of a rudimentary material as presented in the study is thatch, while a finished material is a metal. The ability to live a long, comfortable and healthy life exists as a precursor to freedom. The health of a population precedes its ability to make independent economic decisions that benefit the individual and state economy. Tusting addresses housing inequality and unequal susceptibility to disease in her findings, which further the Sustainable Development Goals of good health and well-being as well as reduced inequalities. To collect this

data, Tusting established classes of housing materials, binary housing quality variables, and conducted malaria testing between 2008 and 2015 across households in Sub-Saharan Africa using microscopy or rapid diagnostic test (RDT).

Tusting investigates the human development issue of how housing inequality changes the susceptibility of a household to diseases like malaria. Tusting hypothesizes that, because malaria mosquitoes typically bite indoors at nighttime, simple improvements in housing materials that prevent mosquitoes from invading homes can drastically reduce the prevalence of malaria in children. The study addresses the confounding variable of wealth differences in Sub-Saharan Africa and combats this by incorporating a wealth index in the study and using a large sampling size across multiple countries. Wealth, access to quality housing, and access to adequate healthcare and preventative measures show a strong correlation. Individual surveys testing for malaria using microscopy revealed that the prevalence of malaria ranged from 0.4% to 45.5% for children in houses in the "modern" class and from 0.4% to 70.6% for children in houses in the "traditional" class. When measured using RDT, the malaria prevalence ranged from 0.3% to 61.2% in modern houses and 1.5% to 79.8% in traditional houses. Based on these findings, Tusting concludes that there exists a strong association between housing quality and the prevalence of malaria in Sub-Saharan Africa. In total, modern housing revealed a 9% to 14% reduction in malaria infection rates for households across 21 countries in this geographic region. This data set urges governments in Sub-Saharan Africa to pursue housing improvements as a method of preventing and controlling the spread of malaria. This association reveals a long-term solution to the malaria epidemic.

3. Thomson, Dana R., et al. “Linking Synthetic Populations to Household Geolocations: A Demonstration in Namibia.” *MDPI*, Multidisciplinary Digital Publishing Institute, 9 Aug. 2018, www.mdpi.com/2306-5729/3/3/30.

Substantive freedom merits representation. For representative democracies such as Namibia, a prime method of achieving freedom of representation is the government census. However, poor participation in the census leads to a gross misrepresentation of the population. What happens when a government cannot realize census data directly? Dana R. Thomson, Lieke Kools, and Warren C. Jochem work to ameliorate this problem through the use of geospatial datasets that create synthetic populations. Simulated, geolocated census microdata furthers the Sustainable Development Goals of reduced inequalities and sustainable cities and communities. Thomson’s team argues that synthetic data provides a more realistic option for researchers to obtain data concerning households and associated characteristics. Synthetic population datasets can generate multiple scenarios to test future census data, which allows actors to generate plans for development in advance of population changes.

This study incorporates a combination of 2011 census data from the Oshikoto region in Namibia, an area in northern Namibia that contains microcosms of diverse populations in the state. The 2011 census surveyed 36,137 individuals in 7536 conventional households out of the 182,000 people living in the Oshikoto region. The region contains a mostly nomadic population, which makes accurate census data unattainable by conventional, door-to-door means. The study evaluates indications of “slum households” from the UN-Habitat definition: “ lack of improved toilet, lack of improved water source, inadequate space defined as three or more people per

sleeping room, and unimproved structure defined as having an earthen or wood floor." These factors, which also include levels of formal education and the presence of children under the age of five, provide a framework for the government allocation of resources to regions in Namibia.

This study addresses the need for a, "population dataset that could be used to develop and evaluate household survey methodologies in general, and gridded population survey methodologies in particular," The simulated census microdata realizes five types of a synthetic population: demographic, socioeconomic, and outcome characteristics at three levels; household, woman, and child. Researchers compared the synthetic population with data obtained in the 2011 Oshikoto census. The study underwent three phases of data methods, which built off of previous research. Previous research used iterative proportional fitting (IPF) to improve the probability distribution of attributes on the person or household level, combined with combinatorial optimization procedures, specifically simulated annealing. The three phases of the study can be summarized as followed. Phase A: Researchers predicted the spatial distribution of household hypes in Oshikoto with methods such as spatial covariates and satellite imagery. Phase B: Researchers generated a synthetic population and assigned the population to a household based on household characteristics. Phase C: Researchers predict future population characteristics. Aside from the practical benefits of a simulated census, this study explores the accuracy of simulated datasets and the ethical implication of using simulated data sets of an entire population versus a smaller, random dataset from a traditional census. Synthetic, simulated populations in Namibia could make a full census microdata dataset a viable alternative to uninclusive, misrepresenting data in the Namibian census.

4. Wardrop, N. A., et al. “Spatially Disaggregated Population Estimates in the Absence of National Population and Housing Census Data.” *PNAS*, National Academy of Sciences, 3 Apr. 2018, www.pnas.org/content/115/14/3529.

Freedom and representation exist in an inextricable entanglement; one cannot exist without the other. In areas where geospatial data is unreliable, infrequent, or unobtainable, data scientists implement methods of population estimates in order to combat this critical lack of information. In Lebanon, the most recent census data comes from 1932. In Somalia, the only public census data comes from 1975. Political instability and civil unrest preclude census takers from performing their research, and corrupt governments block the release of national census data. Adequate representation allows policymakers to surmount development unfreedoms. Nicola Wardrop and her team, published in the Proceedings of the National Academy of Sciences (PNAS), address the UN Sustainable Development Goal of reducing inequalities and have implemented spatially disaggregated population estimates in areas where national census data remains largely absent.

Wardrop addresses the challenge of within-country heterogeneity, which merits special attention to disaggregated data sets within gender, race, ethnicity, age, and disability. She emphasizes the vitality of accounting for these factors to ensure that subnational variations in demographic groups are captured by spatially-disaggregated data. Wardrop and her team introduce the transition from, “top-down,” mapping to, “bottom-up,” mapping as a viable source of spatially disaggregated data. The top-down method of dasymetric mapping techniques

combines satellite remote-sensing technologies and Geographic Information Systems (GIS) to identify human-built structures and allocate a population count based on regional estimates. The bottom-up method builds upon the top-down method, as it incorporates ancillary spatial datasets such as, “distance to roads, slope, age of community, satellite-derived variables, vegetation indices, texture, and surface temperature.” and, “elevation, slope, and night-time lights.” Wardrop asserts that the incorporation of these datasets will refine estimates of human population distribution at an enhanced resolution.

Closing the gap in national census data has applications at the local, domestic, and international levels. Accurate and published census data improves a government’s ability to allocate resources to marginalized populations. Wardrop takes into account contextualized information that other spatially disaggregated datasets ignore, which, in turn, creates the most reliable estimated census data. Governments use census data to plan service delivery and implementation, allocate polling stations and election resources, plan for epidemic and pandemic responses within subpopulations, and provide disaster relief. In settings with poor geospatial data, inaccurate census data slows and weakens a government’s ability to respond to a disaster. Fallacious data remains the most prevalent in countries that suffer significant political instability, such as Afghanistan, Somalia, and Lebanon— the countries in which effective response to disaster is the most crucial— which creates a cyclical process of poor data and poor responses. Wardrop aims to create a system of data collection using GIS and satellite imagery that overcomes the information deficit in resource-poor regions.

5. Tusting, Lucy S., et al. “Mapping Changes in Housing in Sub-Saharan Africa from 2000 to 2015.” *Nature News*, Nature Publishing Group, 27 Mar. 2019, www.nature.com/articles/s41586-019-1050-5.

The UN Sustainable Development Goal 11 aims for, “universal access to adequate, safe, and affordable housing, and to upgrade slums by 2030.” This research paper, pioneered by Lucy S. Tusting, enables this goal and provides a data set that maps changes in Sub-Saharan African housing from 2000-2015. A lack of adequate housing and shelter, including extreme housing inequality within a locality, is a fundamental unfreedom which this report addresses by analyzing housing trends in Sub-Saharan Africa. This report combines geostatistical framework with national survey data to show transformations within both urban and rural housing in Sub-Saharan Africa. Tusting identifies several indicators of improved housing based on the geospatial analysis, defined as durable construction, improved water and sanitation, and sufficient living area. Although the Sub-Saharan African region has seen an increase in improved housing from 11% to 23%, fifty-three Africans living in urban areas live in unimproved housing. Tusting presents these findings as a bridge between reality and understanding of reality that can promote evidence-based policymaking related to the Sustainable Development Goal of improved housing, which has the most acute need in African regions.

This study incorporates datasets extrapolated from national survey data, consisting of 588,892 households across 51 national surveys. It observes datasets including the prevalence of urban slum housing, house construction materials, water and sanitation, and the number of people per room in a household. It operationalizes the definition of “unimproved” versus

“improved” housing with four characteristics of housing, all of which the shelter must not meet in order to gain “improved” status: “(1) unimproved water supply; (2) unimproved sanitation; (3) more than three people per bedroom; and (4) house made of natural or unfinished materials.” Additionally, the study obtains covarieties such as urbanicity, irrigation, travel friction, and night-time lights. Tusting and her team obtained these datasets through data methods such as a geostatistical regression model at 5 × 5-km2 resolution, used to map house materials and house type. In this study, finished flooring materials were cement, vinyl, parquet, or carpet, while unfinished flooring materials consisted of dung, sand, or earth. This study processed data using the R programming language and plotted the dataset using the rasterVis package.

In order to account for statistical anomalies or unforeseen irregularities in housing patterns, Tusting incorporates a beta-binomial likelihood function that accounted for the variation in sampling size across survey data. The study also includes confidence intervals in order to remain transparent about the possible, minimal inaccuracy of the data in housing trends. To combat the confounding variable of wealth as it correlates with housing inequality, the report estimates the likelihood of improved housing, “in relation to education level of the household head, household wealth and age of the household head,” and concluded that the likelihood of improved housing was 80% higher from 2000-2015 in educated households. Researchers also found a greater increase in improved housing for urban areas as compared to rural areas. Overall, Sub-Saharan Africa has seen incremental improvements to housing materials, but suffers from significant housing inequality, as 648 million African inhabitants lived in unimproved housing in 2015.