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Considering climate in studies of fertility and reproductive health in poor countries

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Abstract

Understanding the links between climate and fertility and reproductive health outcomes in poor countries is a major ethical and policy imperative. However, doing so will require researchers in population sciences and in earth and climate sciences to merge their expertise. To this end, the dominant theoretical frameworks and readily available geospatial population data used by social scientists provide a starting point for climate and physical scientists to think about the mechanisms that link climate and weather to fertility and reproductive health, and available climate data and analytic strategies can be used to develop research that considers different scales of influence.

Populations in many of the poorest and climatically vulnerable countries of the world are rapidly growing[1]. Human fertility and reproductive health outcomes, underlying components of population growth, reflect a range of factors relating to individual, household, community, country, and regional characteristics. In the poorest countries and communities, fertility and reproductive health outcomes are also influenced by climate and weather. There are two main reasons why bringing micro-level empirical research that links climate and the environment to distal or proximate determinants of fertility and reproductive health outcomes is a necessary future direction for climate-society research. Note that a broad range of topics related to fertility, maternal/child health, and family planning are grouped within the fertility and reproductive health term (abbreviated to FRH) used here. Micro-level investigations of FRH refer to individual-, household-, or (small) community-level analyses. Micro-level models of these outcomes are often multi-level models containing contextual effects at multiple scales.

First, contemporary fertility transitions – namely those in sub-Saharan African countries – are not proceeding as expected based on theory and previously observed transitions[2–4]. Elevated levels of fertility in the context of rapid population growth in sub-Saharan Africa may be related to unmet contraceptive need or demand for large families. Contextually relevant research that addresses contemporary demographic change is needed because of the importance of empirical analyses for testing, refuting, refining and advancing theories of demographic and health outcomes. Second, population projections that incorporate climate

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change nevertheless ignore the ways that climate might influence fertility and reproductive health[5]. Instead, an incorrect assumption – that there is no reproductively relevant biological or behavioral response to climate change (beyond migration) – has become standard. Factors related to fertility such as population size, composition and rate of growth may influence a community's ability to adapt to a changing climate and must also be brought into the discussion of future scenarios.

How climate impacts FRH over time and space in poor countries is not well understood. In most developing country settings, poor rural people are heavily dependent on their environment for producing food and earning money[6–9]. Even if rural dwellers are not themselves agricultural producers, they primarily live within food and economic systems that rely on successful local agricultural or livestock production. The majority of the poorest families in the world, primarily those in sub-Saharan Africa, depend on small-scale, rainfed agriculture and livestock systems, rather than large-scale mechanized systems[7]. Therefore, when the rainy season is poor because rains start late, are sporadic or do not arrive at all, short- and long-term food availability and economic resources are impacted in important ways[10]. These impacts are reflected in a range of outcomes of relevance to studies of FRH – changes in sexual behavior/coital frequency[11–13], sperm quality[14], birth/fertility goals and planning[15–18], miscarriage, stillbirth and abortion[19–23], psychological well-being[24], and general maternal/child health[25–27]. Additionally, direct impacts relating to the intersection of climate and the natural environment – droughts, floods, heat waves, for example – can also influence FRH outcomes and access to health services[28–30]. While these findings provide a useful point of departure for contemporary climate-FRH research, most existing studies are limited in important ways because they focus primarily on families from rich countries or use aggregated climate or health data that may obscure variation between households and relationships at the individual-level. Similarly, existing research also often fails to distinguish between within-location variation and between-location variation in conditions or outcomes.

To accurately represent the ways that poor people in poor countries live, climate and environmental data, methods, and expertise must be included in the next generation of FRH research. Empirical investigations can be used to enhance understanding of the linkages between environmental conditions to distal or proximate determinants of FRH and they can be conducted by taking advantage of the vast and diverse array of climate, environmental, landscape and spatially-referenced reproductive health data. Researchers can rely on a wide-range of flexible spatial statistical techniques designed to examine correlation and causality. Further, in many cases, the dominant research frameworks from demography and population geography used to investigate micro-level variation in FRH can readily accommodate, and in fact, be further refined and enhanced through the inclusion of climate information and spatial analysis. Micro-level results can, in-turn, be used to produce more nuanced and accurate climate change projections that attend to the dynamic nature of human behavior[5,31]. Given the ongoing efforts to characterize, model, and predict demographic change in the poorest countries where conventional demographic models may be inadequate, researchers have an opportunity to expand knowledge through the use of interdisciplinary micro-level research.

Theories of Fertility and Reproductive Health Variability

We can organize the frameworks used to investigate variability in FRH into three dominant categories: 1) conventional demographic transition theory, 2) the ideational or cultural perspective, and 3) the political economy perspective. Conventional demographic transition theory describes the transition from a historical stage in which a population is characterized by high levels of fertility and mortality to an eventual stage of low mortality and low fertility[32–34]. Typically, mortality falls first, with fertility levels eventually falling to meet or exceed the mortality level. Rapid population growth, as observed in many communities in sub-Saharan Africa, occurs when fertility levels remain elevated while mortality levels decline.

The second perspective posits the importance of cultural change for motivating decreases in family size[35,36]. When researchers investigated historical fertility transitions in European countries (at the province level), they struggled to identify a consistent correlation between economic development and fertility decline. Rather, geographic patterns of fertility decline emerged, revealing that neighboring communities or communities with shared cultural or linguistic characteristics tended to undergo similar fertility change. Fertility declines were observed even in countries without clear economic development.

In response to these perspectives, anthropologists encouraged the development of a political economy of fertility[34]. The idea behind this approach was to consider a broad range of potentially influential forces, including those related to historical, political, economic, social conditions[34]. This political economy approach does not specifically include climate or the natural environment in the formulation, but does encourage close attention to local context, often with attention to how individuals make decisions and engage with their environment. This approach encourages attention to human agency and argues that a local understanding of culture, economics, history, politics, and other factors are necessary in studies of FRH[37].

These frameworks underlie most of the empirical research on the variability in FRH outcomes, including individual-level family size, un-met need for contraception, fertility aspirations, contraceptive use characteristics, unwanted pregnancies, breastfeeding behaviors, birth spacing, seasonality of conceptions and births, sexual behavior, and many others. Empirical FRH research contributes to scientific and policy understanding of processes underlying fertility changes and differences within and across communities and are instrumental in the development and application of public health strategies focused on supporting women and families in poor countries.

Understanding the variation in the onset, pace and timing of the transition from high to low fertility using these frameworks has been of prime importance for demographers, with some input from geography as well[38], and often underlies approaches to women and children’s health policies. These frameworks encourage researchers to specify mechanisms that link the independent and dependent variables and discourage data-driven approaches. Incorporating climate and weather information into these frameworks (or their many off-shoots), and considering how these characteristics vary over time – intra- and inter-annually, for example

– and how they co-vary with FRH outcomes, creates truly interdisciplinary population-environment research.

Links between Climate and Fertility and Reproductive Health

This section builds on the FRH frameworks to demonstrate some of the ways that climate and weather act through time use and physical labor, nutrition and food security, and resource stability and income to directly and indirectly influence FRH outcomes.

Time Use and Physical Labor

Time use and physical labor relate to fertility and reproductive health outcomes through biological and behavioral mechanisms. Biological ability to reproduce may be impacted because more time spent in physically demanding activities can potentially impact a woman's health, particularly if she is pregnant or breastfeeding and already nutritionally deficient[39–41]. In research on birth variability and seasonality, temperature is often cited as an important factor relating to pregnancy health and birth outcomes, with hot temperatures potentially causing greater adverse affects[21,28,29]. Of the limited research that addresses links between climate and FRH outcomes in poor, rural women in poor countries, results suggest that if a woman is exposed to hot temperatures above a particular threshold during a pregnancy, she is more likely to have negative birth outcomes, potentially including miscarriage, stillbirth or low birth weight[28,29,42]. Further, sperm quality can be impacted by high temperatures which could impact male fecundity and ultimately lower conceptions[14,43], although this finding is not conclusive[44].

Behaviorally, couples or individuals may choose to avoid pregnancy or sexual activity during specific times of year because of the physical demands of harvest or weeding, for example[41,45–47]. Further, seasonal rainfall quality, issues with pests or diseases for plants or animals may vary by year, influencing the amount of labor required on the part of the household and individual. If a rainy season is poor, a nomadic pastoralist community may need to travel greater distances to access the water needed for livestock[48,49]. In some communities this could result in the male partner traveling with his herd and causing a longer than normal duration of couple separation, leading to a reduction in sexual activity or a delay in marriage[50]. These separations may reduce conceptions, which could increase spacing between births or reduce the number of births. Additionally, out-migration, seasonal or long-term, could also increase or decrease fertility aspirations depending on the community culture and individual goals relating to family size[16,47].

Individual exposure to high temperatures due to time use and physical labor requirements varies across spatial scales and requires consideration of multiple levels of influence. Cultural norms may dictate who in the household is responsible for a particular aspect of agricultural production, for example, or who has access to technologies that might reduce time spent outside or labor demands[51–54]. Gender norms can also determine ownership of the plot and of the harvest and can modify how much time an individual invests in the land[51,52]. As an example, women in peri-urban Ouagadougou, work on their husband's plots of millet or corn in the cooler morning hours but manage their own plots, often accompanied by their small children, in the hotter afternoon hours. In their own words, these women reported a sense of physical and psychological stress if they happened to be pregnant during periods of intense outdoor labor because of fear of miscarriage or an unhealthy baby at birth[45].

Understanding variation in hours dedicated to agricultural work or animal husbandry and how this time demand varies monthly, seasonally, with age, with reproductive goals, and with social status, may contribute to greater understanding of how and why FRH outcomes vary according to climate and weather. While there is a small body of recent research investigating how land use impacts the demand for children[55–57], this research does not routinely incorporate weather or climate. Similarly, data that examines differences in time-use with attention to culture and gender has been collected for many countries but the data are usually only available for a single year and are often not geo-referenced or easily accessible. Because climate and environmental characteristics can vary dramatically over a relatively small spatial scale[58–61] and behavioral responses may be shaped by individual experiences, this information is most useful when it can be merged with other sources of data to help capture differences both between communities and individual experiences.

Nutrition and Food Security

Fertility and reproductive health researchers and a wide range of policy-makers have focused extensively on the importance of women's nutrition. A modified version of the framework developed by the Food and Agriculture Organization (FAO)'s Food Insecurity and Vulnerability Information and Mapping Systems highlights the array of factors influencing health outcomes, including women's nutrition[62] (Figure 1). When women are adequately nourished they experience a wide range of improved reproductive health outcomes – they are less likely to have miscarriages or stillbirths, and their babies are more likely to be born at a healthy birth weight and at a healthy gestational age[25,63]. Well nourished women and babies are also thought to be better equipped to breastfeed "optimally" and therefore support the healthy growth of a baby who will then be better positioned to become a healthy adult.

Because exposure to hot temperatures can also impact FRH outcomes through increased risk (or perception of risk) of miscarriage, stillbirth or low birth weight[28,29,45], local weather conditions can complicate an analysis of food insecurity, nutrition and FRH. Up through the 1990s population scientists considered the fertility-nutrition link and developed useful frameworks for thinking about seasonality of births, nutrition, and fecundity and how behavioral responses to seasonal changes or food insecurity might impact birth outcomes[41,42,47,64–66]. These analyses were useful for providing empirical insight into the more theoretical and conceptual models of fertility and fecundity, but they were characterized by limited data or studies of very small spatial scope.

Using existing data and frameworks, contemporary research that investigates the different ways that heat stress, for example, contributes to miscarriage, stillbirth, or time to conception, while also accounting for food insecurity or seasonal hunger could be used to uncover the ways that climate, food insecurity and nutrition interact. These types of analyses would result in a modification of the FAO framework that require considering the impact of climate on individual health outcomes directly. The line linking climate to individual-level responses represents this modification and is not original to the FAO framework. Related contemporary work focuses on seasonality of births/conceptions with some attention to temperature, but this work makes limited connections to food insecurity and biological or behavioral FRH outcomes beyond those related to child health[67,68].

Resource stability and income

The final area of investigation highlighted here is the role of household income in FRH. Household- and individual-level income or resource access are routinely considered in studies of FRH. Income levels can contribute to determining the resources available for children or can be related to the demand for children[69]. Income and access to income can also relate to women's empowerment and agency in the household which may impact their fertility levels, contraceptive use or family size goals[70,71]. In rich countries, resource instability is associated with changes in fertility goals and fertility timing[72,73]. For poor people in poor countries, resources that are available to the household are dynamic because they are often strongly related to factors dependent on climate and weather - agricultural production, livestock or labor needs.

In poor countries, data limitations and different economic systems challenge researchers to use alternative measures of income and resource stability. Household-level health or development surveys frequently include information relating to household assets like television ownership or the type of floor material found in the home. Such measures allow researchers to estimate household resources using asset-based indices or through the use of specific variables that capture contextual variation[74–77]. Other surveys, like the World Bank's Living Standards and Measurement Study (LSMS), specifically gather information about consumption and expenditures which is used in various ways to estimate socio-economic deprivation or access to resources[69]. While these measures are more useful than household income, these metrics often perform poorly when used to estimate women's resource access[78]. Using sub-optimal metrics to describe women's resources perpetuates misinformation about women's social and economic status and undermines analyses. The United Nation's Evidence and Data for Gender Equality (EDGE) promisingly focuses on gender-specific measures of resources but is limited in spatial and temporal scope (only two sub-Saharan African countries are included in their pilot work).

In communities where incomes are often not cash based and household assets or current employment might not sufficiently represent variability within a community or over time, the use of time-varying climate information provides vital information on resource access and availability. In addition, other environmental or land use information, commonly used survey-based metrics, and climate data can be combined to approximate resource availability related to employment, food, cash crops or livestock health. For example, in the peri-urban communities near Ouagadougou mentioned earlier, some poor women collect sand and pebbles to sell to supplement their incomes. This work is impacted by rainfall – sand collection cannot occur if the rains are too heavy because it is too difficult to transport the full wheelbarrows. This seasonal work generates income for some peri-urban women[45]. In this case, without detailed income information, the amount or intensity of rainfall during a particular season could help to determine the number of working days and the resources available to women who collect sand.

Similarly, related data can also be used to classify households or communities as highly dynamic in terms of resource stability. In considering how the environment relates to individual households' resource access and availability, scientists can investigate the ways that a shorter rainy season might impact the affordability of contraception, for example, for women who live in pastoralist communities and rely on rainfall to support their livestock. Further, questions of un-met contraceptive need, when women want to avoid a pregnancy but are not using contraception, can be investigated in more complex and context-specific ways, perhaps with attention to the seasonality of un-met need or the spatial variation of un-met need[79].

Moving Forward as a Research Community

Meaningfully including climate in studies of fertility and reproductive health requires tools, data and theory from physical and social sciences. Vast amounts of data, methods and frameworks already exist that can be exploited to more thoroughly and accurately represent the ways that women and families experience conceptions, pregnancies, abortions, miscarriages, stillbirths, childlessness, and a range of other related outcomes. Extant climate, population, health and land-use data can be combined in specific ways to support the investigation of a range of hypotheses. Future data collection efforts supporting FRH research in sub-Saharan Africa should also focus on incorporating questions that can help to capture variation in how individuals use their time and how they respond to weather changes. One approach is to expand the UN's EDGE data collection to include more countries and more health data.

Merging Population and Climate data

To study the effects of climate on FRH, one needs data that include measures of key climate variables and relevant FRH outcomes, as well as any intervening variables relevant to the specific hypotheses under study[80,81]. Survey data that report individual-level information on health, fertility, development and land-use is vital for analyses of the sort encouraged here. Spatially referenced individual- or household-level data is necessary for studies of behavioral and biological responses to local climate and weather variability. Longitudinal data is ideal for investigating causal linkages, but retrospective survey data that contain detailed information on the timing of pregnancies, births, contraceptive use, and other reproductive health outcomes can also be used.

Demographic and Health Survey (DHS) data or Health and Demographic Surveillance System (HDSS) data are frequently spatially referenced and provide extremely detailed data on health outcomes of the poorest people in the world (beginning in the mid-1990s DHS data have been spatially referenced). Spatial and temporal resolution varies, but sample sizes are typically well above 5,000. HDSS provides longitudinal data. The DHS contains detailed information on child/infant health and mortality and also contains (in most cases) retrospective monthly contraceptive/pregnancy calendars for the five years preceding the survey date. DHS cover a larger geographic region and the data are easily accessible online. These data are almost always spatially referenced at the "cluster" level[82,83] enabling spatio-temporal analysis using climate data. The previously mentioned Living Standards

Measurement Study (LSMS) provides information on anthropometrics, educational-attainment, consumption, expenses and household assets for a selection of surveyed households in poor countries. The addition of the Integrated Surveys on Agriculture (LSMS-ISA) provides additional information, at several time periods, on the agricultural and livestock holdings of surveyed households. The LSMS-ISA routinely contains spatial information to facilitate spatially harmonizing this data with other sources of data. Beyond these widely available, large-scale datasets, there are countless population, health and land use surveys led by research teams that contain spatial information and could therefore be merged with climate data.

The overwhelming majority of poor countries do not typically collect adequately fine spatial and temporal scale data on food production, yield, harvest or related information – key variables for analyses of the fertility-nutrition link. Climate and remotely sensed data can provide key information, in monthly, weekly, or even daily time intervals that allows researchers to approximate a range of food production variables at household-scales[30,84–86]. The data and models from the climate and food security community can be combined with perspectives on fertility decline, such as those described earlier, to support research on food insecurity and human reproduction. Useful data are listed in Table 1.

Fine-scale (where spatial scale is < 10 km) climate data and products derived from this type of data - drought indices, soil quality measures, vegetation indices, malaria indices - can be aggregated over space and time to investigate theory-driven hypotheses. Researchers can use retrospective health data in combination with detailed climate data to investigate within- or between-community variation to limited-duration weather events, like heat waves or floods, or to longer term slow-onset climate change which might contribute to reducing the suitability of the land for agriculture, for example. Researchers can also aggregate and combine data in ways that reflect results from ongoing qualitative investigations focused on understanding perceptions of climate change or identifying particular behavioral responses towards a late starting rainy season, for example[87–89]. A common way to assemble such data is to link variables from multiple sources at the level of the spatial or geographic unit. Micro-level human health data reflects variation at a fine spatial and temporal scale. Therefore, climate data that captures relevant spatial and temporal variation is required for investigations that examine within- and between-community variation. Figure 2 demonstrates the different spatial and temporal scales involved with a research project focused on investigating birth outcomes and heat stress among food insecure individuals[29].

Analytic Approaches

There are a wide range of statistical approaches that can be used to evaluate the relationships between landscape, environmental data, and fertility and reproductive health outcomes. The ideal approach must reflect the research objective, the theoretical framework and the data. Merging FRH data with climate and environmental data requires attention to the temporal and spatial scales of the events under study, as well as the spatial and temporal variability of the environmental features. For instance, when considering women's time use in a given community in Burkina Faso, the amount and frequency of rainfall will have notable impacts on the type of physical labor an individual engages in over the course of a week or month. If the woman is in a later stage of pregnancy, changes in physical labor could impact the health of her pregnancy or her perception of her pregnancy's health[45]. Given within-community variation in land-use and household resources, however, there is likely variation in individual responses to rainfall and resulting health outcomes. This example demonstrates the importance of close attention to the spatial and temporal processes underlying the variability in the outcome measure and attention to the hypotheses under study.

Often times independent and/or dependent variables must be aggregated over space or time while attending to the research objective and the particularities of the context. Multi-level models are a useful approach when dealing with different spatial or temporal scales because they allow an analyst to "nest" an individual into a context[90,91]. The context can be a neighborhood, a community, an agro-ecological zone, a climate zone, or some other relevant unit. Nesting individuals within a specified context allows evaluation of variation between these contexts but also of individuals within these contexts[90]. Multi-level models can be used to test hypotheses comparing the relative importance of seasonal rainfall versus individual socio-economic characteristics in pregnancy outcomes during a given year. There are many examples of multi-level models that demonstrate their use in FRH analyses[29,30,92]. They can also be used to explore and describe the variation in poor versus rich women's birth outcomes while also considering heat exposure (temperature data is usually available at a coarser spatial scale). Contextual information can also be incorporated into event history models. Using these models, an analyst can examine how risks of particular outcomes change over time and with attention to context[93]. For example, a researcher interested in examining the relationship between rainfall variability and individual experiences with stillbirth could estimate an event history model using individual-level retrospective DHS data combined with time-varying precipitation data from CHIRPS.

Generalized Additive Models (GAMs) can also be used to investigate various relationships. GAMs allow for flexible modeling and are ideal when the objective is to predict outcomes. Because GAMs rely on non-parametric smoothing functions, the relationships between the predictor and the outcome variables are not determined in advance; these models therefore allow the underlying patterns of the data to drive the fitting[94]. Rather than producing a single slope that represents the relationship between the predictor and outcome variable, which would likely be incorrect in the case of rainfall and agricultural yield, for example, where too much or too little rainfall in a given season would indicate a problem, the GAM curve allows a researcher to identify a more complex and context-specific relationship[95]. Spatial GAMs would be useful to help generate hypotheses relating climate to health or can be used to integrate remotely sensed data with climate data to predict agricultural characteristics[16,96].

Beyond these flexible approaches, when researchers consider the unique impacts of the environment on the communities under study, there are a host of statistical and mathematical approaches that will facilitate an analysis of these factors. Many research advances in geovisualization, spatial optimization, multi-scalar research, and mixed-methods (quantitative-qualitative approaches) applied to the study of linkages between climate, weather and FRH outcomes could yield important insights.

Conclusion

The purpose of this article was to motivate micro-level (individual-, household-, and community-level) empirical research that expands on existing social science research frameworks that link climate to distal or proximate determinants of fertility and reproductive health outcomes. This article highlighted the types of frameworks, data, methods that can be used to undertake these analyses. Attentively incorporating local climate and weather features into quantitative investigations of the spatial and temporal variability in FRH outcomes will expand and improve scientific and policy understanding of reproductive health and fertility in the poorest countries. Analyses like these will also support and inform the development of policies related to contraceptive use (and unmet contraceptive need), food insecurity, psychological well-being as it relates to childbearing aspirations, breastfeeding, and other related experiences of childbearing women and couples in poor countries. Some researchers, particularly those employing quantitative techniques, have inappropriately assumed that conventional demographic transition theories can sufficiently describe the variation in fertility and reproductive health outcomes without attending to within-community and between-community variation[38]. Contemporary trends in sub-Saharan Africa that indicate stalls in fertility transitions, low use of contraception, high childbearing goals, and other related outcomes, do not coincide with the patterns that researchers had necessarily expected to observe. Ongoing investigations that empirically test theories can allow for refining scientific understanding of why populations change the way they do or why they stay the same. Further, modifying population-environment scenarios to account for the variability in the behavioral and biological components of FRH outcomes can improve the usefulness of population projections and policy responses[5]. Given the wide range of spatial health data and the wide range of freely available climate data, now is an excellent time investigate these questions to move science and policy forward.

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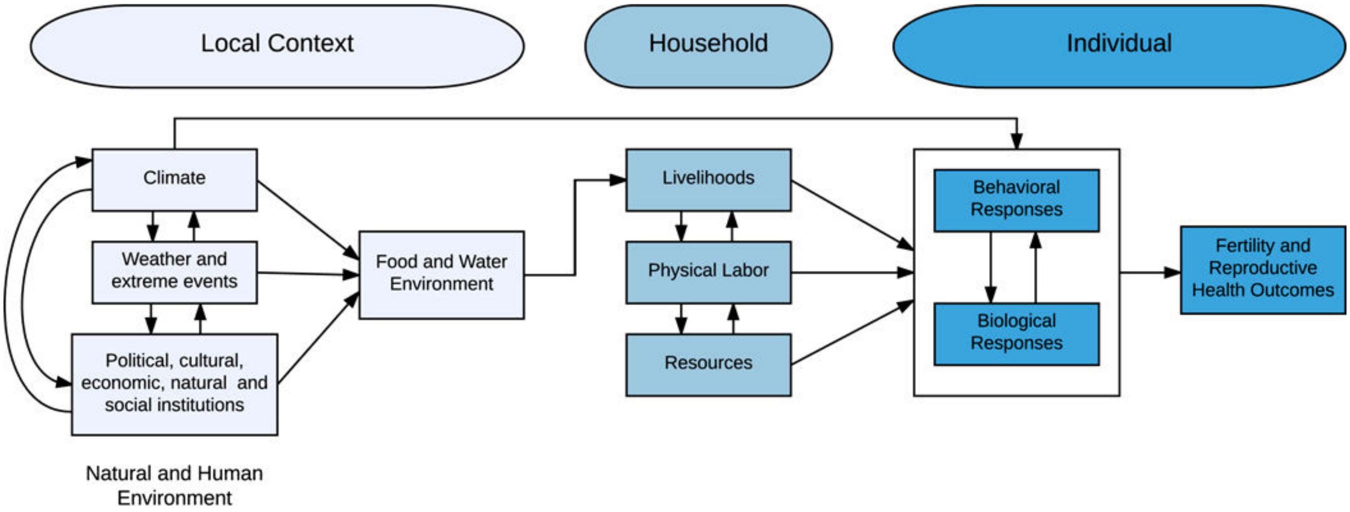

Figure 1. Conceptual framework linking short- and long-term observable parameters to fertility and reproductive health outcomes

Source: Author's expansion of the framework developed by the Food and Agriculture Organization (FAO)'s Food Insecurity and Vulnerability Information and Mapping Systems

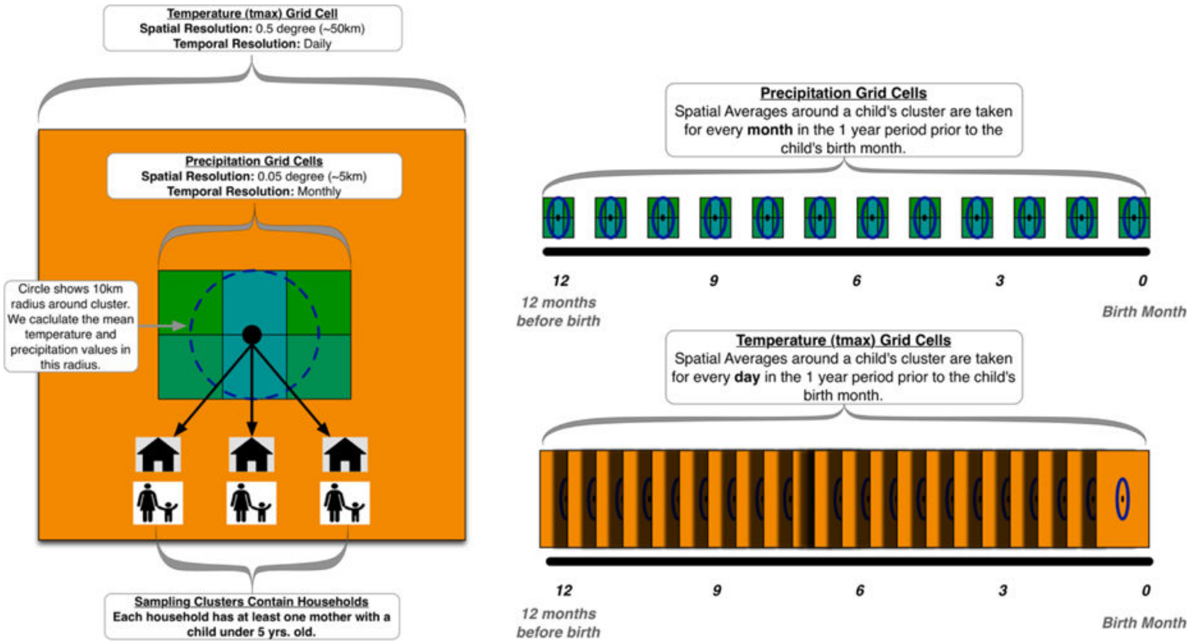

Figure 2. Merging data of different spatial and temporal scales

Here, data of differing spatial and temporal scales is merged to capture heat stress (count of days above a threshold temperature, *tmax*) for each trimester of pregnancy. The outcome of interest is low birth weight. Monthly precipitation is also included to measure quality of the growing season, a proxy measure for food availability. Health data are organized with births nested within women, then women nested in households, which are then nested in communities (or spatial clusters). The spatial information of the community is offset by 5-10 km to maintain confidentiality of the respondents. The offset requires the user to average over a 10 km radius.

Source: Graphic developed by Frank Davenport

Table 1

Examples of useful population, climate, remotely sensed, and land use data

Dataset	Uses	Spatial Resolution	Temporal Resolution
Demographic and Health Survey Data (DHS)	Individual-level FRH information	2-10 km	Varies
Health and Demographic Surveillance System (HDSS)	Individual-level FRH information	Access varies	Varies - longitudinal
World Bank's Living Standards Measurement Study -ISA (LSMS-ISA)	Land use, food and income acquisition	10 km	Longitudinal (in most cases)
Climate Hazards group InfraRed Precipitation with Station data (CHIRPS)[86]	Drought, flood, growing season, malaria	0.05 degree	5-day, 10-day, monthly, annually, 1981-present
Famine Early Warning Systems Network (FEWS NET) Land Data Assimilation System (FLDAS)[87]	Hydrologic drought, water availability, soil moisture	0.10 degree	Daily, monthly, 1982-present
MODIS vegetation (NDVI and EVI)[88]	Vegetated area, livestock grazing potential	250 meter	16-day, 2000-present
Livelihood zones (Famine Early Warning Systems Network)	Food and income acquisition	N/A	N/A