Revealing food systems through the development of nutrition-based farm typologies

Eradication of food and nutrition insecurity requires effective mainstreaming of nutrition into all the relevant sectors (e.g., agriculture, health, education, and markets) and activities (e.g., processing, distribution, and consumption). This in turn requires leveraging multi-disciplinary and multi-layer data and advanced analytical and visualization tools.

Our idea: to analyze existing data on farming systems; nutrition and health; market access; and several other spatially-explicit biophysical data layers in sub-Saharan Africa (SSA) to examine the linkages between the different elements of food systems. The following are some of our working **hypotheses**: (1) there is significant heterogeneity in the resilience of farming and food systems to climatic and weather changes, (2) more diversified farming systems (e.g., mixed crop-livestock or cereal-legume) are associated with better (diversified) nutrition and health outcomes, *ceteris paribus*. (3) households with better market access have better quality diets than those with limited market access.

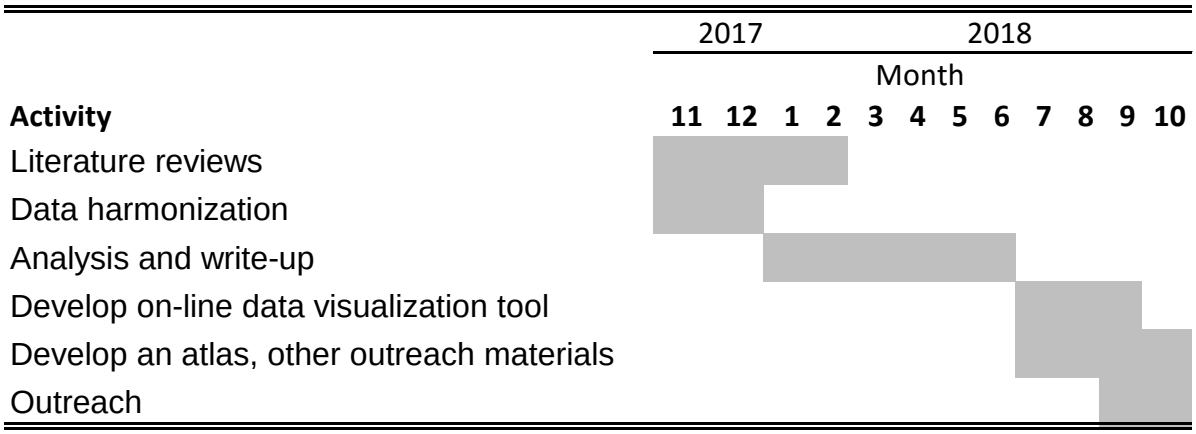
While access to (spatially-explicit) data on agriculture, nutrition, and health has increased in SSA over the years, a lot more work is needed to systematically analyze different data to generate evidence that would assist with better understanding of the intricate links between the different aspects of food systems – socioeconomic, cultural, and environmental. Such exercise is crucial to identify potential entry points that maximize the impact of interventions.

Data: the source of multidisciplinary, spatially-explicit, bio-physical and economic data is CELL5M from HarvestChoice. Data on the spatial distribution of crops come from IFPRI's Spatial Production Allocation Model (SPAM). Individual- and household-level data on nutrition and health will be obtained from ARENA, a project also led by IFPRI. ARENA has recently harmonized data from all the available rounds of the Demographic and Health Surveys (DHS) opening new opportunities for a comprehensive and, for countries with multiple DHS rounds, dynamic analysis. For this pilot project, we will use DHS data from the most recent surveys in SSA.

Method and deliverables: geospatial and economic analysis will be conducted to shed light on the complex interactions between the environment, farming systems, nutrition, and health. We will introduce machine learning (ML) to the classification of DHS clusters by combining their dietary, anthropometric and wealth index data with various data layers including market access, climate, and farming systems. ML algorithms would then be used to classify locations along a few key dimensions such as agricultural suitability, population density, and remoteness. An atlas summarizing the typologies will be developed. An interactive online data visualization tool will also be developed to facilitate the understanding of the identified relationships and trends. Policy briefs and journal articles will be prepared and disseminated. Harmonized data will be made available to the public through Dataverse.

Implementation plan: the pilot project is a collaborative effort between IFPRI, a lead center for CGIAR's Agriculture for Nutrition and Health (A4NH) Program and Tufts university. IFPRI will lead the geospatial and economic analysis while Tufts will oversee the ML exercise. Of the $100,000, 20% will be used to cover a statistician's time from Tufts university. 65% will be used to cover the time of the following staff at IFPRI: one GIS specialist who will lead the development of an atlas; one research assistant who will reviews published and grey area literature in the context of the hypotheses to be tested and assist

with the data harmonization; one research who leads the geospatial and economic analysis; and a senior research fellow to guide with the economic analysis. 10% will be used to develop an online data visualization tool; 5% will be used to cover outreach/travel related costs. The timeline of activities is summarized below.



Next steps: a similar exercise will be conducted using comparable health and nutrition data from earlier DHS rounds in SSA spanning 10 – 20 years, depending on the country. This dynamic analysis will shed light on the evolution of nutrition and health outcomes within the context of other land-scape level climatic, weather, and policy changes that have occurred.

For an in-depth analysis of the agriculture-nutrition linkage within the framework of the typologies we will be developing, case studies will be conducted focusing on selected SSA countries for which there are detailed, geo-referenced, and (in some cases) repeated panel agricultural data collected as part of the LSMS-ISA initiative. We will also explore possible synergies between our project and other food and nutrition projects led by IFPRI or Tufts university where our methodology could be applied.

Depending on the availably of funding, our approach will be expanded to countries in other developing regions of the world (e.g., South Asia) for which DHS data have also been harmonized as part of ARENA project, and in which IFPRI has been conducting research that examine the links between agriculture, nutrition, and health.

Selected in-country trainings will be organized for evidence sharing and for introducing our online data visualization tool and atlas to relevant policy makers. Lack of operational tools for professionals and policy makers to effectively integrate nutrition into their work has been a major challenge and these trainings would be crucial to enhance the impact of this project.