SEAMEO SEARCA
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Vol. 7 No. 5
ISSN 2225-9694

AGRICULTURE AND DEVELOPMENT NOTES
CLIMATE CHANGE ADAPTATION

Assessing Sustainable Nutrition Security: The Role of Food Systems[1]

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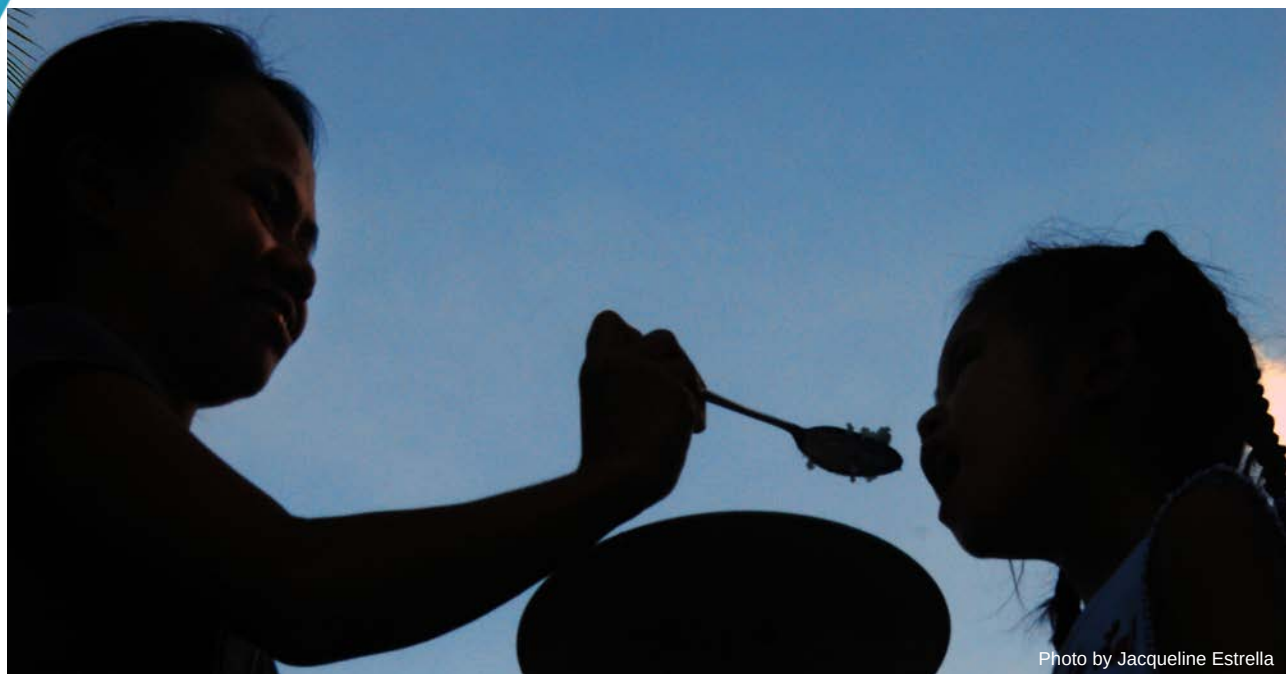

Photo by Jacqueline Estrella

The world's food systems face an escalating challenge to meet accelerating demand for sustainably-produced, nutritious food in the face of multiple threats, including human population pressure, dwindling resources, and degraded ecosystems. About 1 billion people lack sufficient food and about 2 billion people suffer from a number of micronutrient deficiencies.

Paradoxically, more than 2 billion adults are overweight, of which 500 million are obese. These current challenges to food systems and nutrition security cast an even more ominous shadow into the future when they are considered in the context of intensifying climate change. The fifth assessment report from the United Nations Intergovernmental Panel on Climate Change (IPCC) highlighted the effects of climate change and water availability on crop yields; the results indicate largely negative impacts on food prices and food accessibility. The US Third National Climate Assessment report also emphasized food security threats due to climate change effects on food processing, storage, transportation, and retailing. Indeed, the US team that produced this national assessment took the unusual step of issuing a special report, prompted by recent extreme weather events (i.e., drought, wildfire, storms, and flooding).

The specific climate change and water availability adaptation challenges for food systems are daunting. In presently dry regions, drought frequency will likely increase, and on-going climate change means that all areas are likely to suffer more frequent episodes of severe drought, with potentially devastating impacts on food security. Although there is still considerable uncertainty in climate model predictions, a number of geographically-specific "hotspots" likely to experience multi-sectoral impacts have been identified around the world. The most vulnerable regions are generally associated with predicted changes in water availability with respect to severe water scarcity and flooding risk. Crop irrigation will become a more essential adaptation strategy, but there are many important food production regions where this will not be sustainable in the long-term due to depletion of aquifers and reductions in both glacier- and snow-melt. A number of indirect effects are important as well, especially the movement of pests and diseases into new ecoregions.

The overall net effect on crop yields, commodity prices, and food availability are assessed through the use of so-called "integrated models," which are generally constructed by linking climate, crop, and economic models. The science of integrated modeling, which has advanced rapidly in recent years, is now being used to assess alternative adaptation strategies and potential interventions in food systems intended to improve nutrition security and sustainability outcomes. However, the underlying models being used in these assessments are often based on insufficient data and model assumptions that have not been fully tested across the systems critical to nutritional security. Yield reductions of more than 25 percent have been predicted for important grain crops

due to climate change. These impacts on crop yields translate into effects on prices, land use conversion, and total food production. Net impacts on global food prices through 2050 are estimated through the integrated models to range from negligible to more than 60 percent price increase.

Fortunately, there is growing evidence that innovations in agriculture can play a major role in boosting production, keeping food costs down, thereby improving food security – through the process of sustainable intensification. Sustainable intensification can help close yield gaps (the difference between observed and theoretical crop yields) and can also contribute to climate mitigation, by significantly reducing the carbon footprint of food production. For instance, shrinking global maize yield gaps to the levels achieved in the US would produce an additional 335 million metric tons of maize grain. Countries with high levels of intensification (e.g., Argentina, Brazil, and the US) are also generally achieving higher levels of eco-efficiency, as measured by per unit of production of greenhouse gas emissions and the utilization of land, water, and energy. These countries are seeing their eco-efficiency levels increase more quickly than countries not pursuing a sustainable intensification strategy. During the first decade of the 21st century, high intensification countries saw eco-efficiency increases in four major row crops: canola (26%), cotton (23%), maize (17%), and soybeans (18%). In contrast, low intensification countries had no change in eco-efficiency during this same ten-year period.

These trends are especially troubling when one considers that climate change is causing increased intensity and frequency of extreme events, thereby increasing the possibility of large downward annual shortfalls in the production of multiple grain crops, such as maize, rice, soybeans, and wheat. Such a scenario would lead to food price shocks, which would have different effects based on a country or region's economic and social conditions. For instance, Africa is more vulnerable because of lower food production, while Australia is more resilient since food is relatively plentiful, reliance on imports is low, and only a relatively small fraction of income is required to purchase food. In Asia, the Philippines is one of the countries considered to be a climate-induced food security hotspot.

Several factors have led to increased vulnerability of food systems, including:

- Chronic underinvestment in agricultural research;
- Increase in the range and productivity of weeds, insects, and diseases;
- Biological and physical degradation of soil health;
- Over-reliance on a small number of crops and varieties;
- Unsustainable use of groundwater and fossil-based energy; and
- Increasing demand for meat and other resource-intensive food.

In response to these challenges and limitations in previous assessment methodologies, especially the lack of an emphasis on nutrition and sustainability, a new methodology has been developed by ILSI Research Foundation based on the concept of "sustainable nutrition security" (SNS). This novel assessment methodology relies upon the evaluation of seven food system metrics that cover a range of topics related to food security and sustainability:

- Food nutrient adequacy,
- Ecosystem stability,
- Food affordability and availability,
- Sociocultural wellbeing,
- Food safety,
- Resilience, and
- Waste and loss reduction.

Each of the metrics comprises multiple indicators that are combined to derive an overall score (0-100). A novel SNS assessment methodology based on these metrics can be deployed by decision-makers and investors to set meaningful goals, track progress, and evaluate the potential impact of food system interventions intended to improve sustainability and human nutrition outcomes.

Photo by Jose Melencio Bello

[1] *This learning note is based on Dr. David I. Gustafson's presentation at the 2nd International Conference on Agriculture and Rural Development in Southeast Asia held on 12-13 November 2014 in Makati Shangri-La, Manila, Philippines.*

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Packaged into an Agriculture and Development Note by Malaya N. Montesur

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