

Chapter 23

Food Security Indicators for Subsistence Farmers Sustainability: A System Dynamics Approach

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ABSTRACT

Food security concepts are extensively used in households as a measure of welfare, to conceptualise operational usefulness in the design, implementation, and evaluation of policies. Most research is focused on improving food security and sustainability and the patterns still remain tenuous. This article explores food security indicators for sustainability by using system dynamics to understand the interconnectedness of the food security system. This is done by analysing quantitative and qualitative concepts of food security indicators. The simulation result shows dynamics of cropland decreasing with increasing population as they need food, energy and space to survive.

INTRODUCTION

Food security is measured in the dimensions of availability, accessibility, utilization and stability. Household food security is the capacity of a household to procure a stable and sustainable basket of adequate food (Owino et al., 2014). Adequate food availability is necessary but does not guarantee universal access to sufficient, safe and nutritious food (Carletto et al., 2013; Barrett, 2010). Adequacy may be defined in

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terms of quality and quantity of food, which contribute to a diet that meets the nutritional needs of all household members. Access is closely related to social concepts of individual or household well-being and reflects the demand side of food security, as manifested in uneven inter- and intra-household food distribution and in the socio-cultural limits on what foods is consistent within a community (Carletto et al., 2013; Barrett, 2010).

On the other hand, utilization reflects concerns about whether individuals and households make good use of food to which they have access; fostering greater attention to dietary quality, especially micronutrient deficiencies associated with inadequate intake of essential minerals and vitamins (Carletto et al., 2013; Barrett, 2010). Lastly, stability implies access to adequate food at all times, independent of shocks (such as economic or climate related shocks) or cyclical patterns (Oyo & Kalema, 2016). This includes issues of seasonal food insecurity, such as the agricultural period before harvest known as 'the season of hunger'. Stability is the household's ability to procure food across seasons and transitory shortages or the long-term ability to maintain consumption levels while sustainability covers resource use and management, human dignity, and self-reliance, among others (Owino et al., 2014; Connolly-Boutin, & Smit, 2016).

Food system is a well-managed process of production, processing, distribution and consumption by using a strong set of regulations to develop a healthy and wealthy community (Nath & Islam, 2011). In a vulnerable system, even a small disorder may cause significant adverse social consequences especially for those who are most vulnerable such as the rural poor in developing countries (Ericksen, 2008a, b; Adger, 2006; Ericksen, 2006). The conventional agricultural science and policy does not explain complexity, diversity, uncertainty, and non-equilibrium states. Nevertheless, poor people who are dependent on agriculture for their livelihoods live in complex state of affairs (Guma et al., 2016; Thompson & Scoones, 2009). The problems presented by the food system are often non-linear in nature, cross-scale in time and space and dynamic in character where critical minority of policy-makers and citizens are demanding holistic solutions that address such complex problems (Guma et al., 2016). The magnitude and impact of crises and disasters further increases with over exploitation of natural resources and climate change where more households, communities and governments in Africa are less able to absorb, recover and adapt; hence, making them more vulnerable to future shocks (FAO, 2017). Moreover, past researchers have studied food production, food security and livelihood independently, and yet these are interlinked and need to be studied holistically (Oyo, 203; Thompson & Scoones, 2009).

On the global scene, at least 925 million people suffered from hunger in 2010 which represents 13.5% of the world population (Sasson, 2012). The world population is estimated to rise by 70% in 2050 (Tajuba, 2016). The effect of rising population causes rapid change in food demand responses (Guma et al., 2016). This further creates pressure on the agricultural systems to match future food production needs. Other factors that constrain food security include: price volatility owing to competition for food and bio-fuel production (Hubbard & Hubbard, 2013; Pruyt & De Sitter, 2008); climate variability and extreme weather conditions (Tadesse et al., 2014); and dietary patterns characterized by food consumption beyond physical need (Sage, 2013). In sub-Saharan Africa, the food security system is further hampered by resource scarcity (land and agricultural inputs such as seeds, fertilizers), environmental degradation (declining soil fertility, deforestation, and surface water eutrophication), market failures and weak public/donor policies and support initiatives (Oyo & Kalema, 2016).

In response, African heads of state pledged 10% of the national budgets expenditure on agriculture to food security issues in sub Saharan Africa under Maputo Declaration of 2003; however, this has never been realized by the majority of the signatory countries (Harvey et al., 2014). Equally, the pronounce-

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