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Agricultural interventions for improved nutrition: A review of livelihood and environmental dimensions

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ABSTRACT

A diverse group of agricultural interventions aim to improve the nutritional status of women and children. These interventions range from the cultivation of bio-fortified crop varieties to home gardening to livestock intensification. We systematically review 42 evaluations of agricultural interventions for improved maternal and child nutrition. Using these evaluations, we identify three intervention typologies – Enhancement, Diversification, and Substitution – that reflect the differential impact of interventions on household livelihoods and patterns of food consumption. Our typologies allow for a nuanced approach to categorize and generalize about pathways of impact for agricultural interventions. In applying our typologies to existing evaluations, we summarize the evidence base and emphasize areas for further inquiry, particularly in terms of understanding these interventions amid complex environmental, political and economic local contexts.

1. Introduction

A substantial proportion of the world's 795 million people who are unable to meet daily food needs are food-producers, such as small-scale farmers and fishers (FAO, 2015). Policies and programs increasingly seek to address the co-occurrence of malnutrition and food insecurity in farming households by improving nutrition through agriculture. Interventions in this arena promote strategies ranging from home gardens to biofortified crops to fish farming. By improving the quality, quantity, and diversity of smallholder production, these efforts attempt to improve nutritional status of women and children in targeted households.

Many of the major gains in curbing malnutrition in the last half century have been made through nutrition-specific interventions, such as supplements (e.g. iron supplements or folic acid supplements for pregnant women), fortification (e.g. fortification of salt with iodine), and nutrition education (Bhutta et al., 2013; Bhutta et al., 2008; Smith and Haddad, 2015). Yet food-based solutions that expand agricultural production of nutritious foods have possible benefits that do not exist for specific supplementation and fortification efforts. For example, such solutions can support both the livelihoods and nutritional status of smallholders, while having the potential to more sustainably address persistent rates of malnutrition (Pinstrup-Andersen, 2013). Food-based solutions have the potential to confront nutritional needs directly and within the contexts of the primary source of macro and micronutrients (Demment et al., 2003; Burchi et al., 2011). These approaches are oriented to improve food security and provide households with a variety of foods that can meet multiple dietary and micronutrient requirements (Blasbalg et al., 2011; Tontisirin et al., 2002). However, agricultural approaches to nutrition are often less targeted than specific supplementation and fortification efforts, both in terms of the specific micro/macro-nutrients provided, and in terms of the specific person in the family receiving the benefits.

The Sustainable Development Goals have prioritized a goal of simultaneously reducing hunger and promoting sustainable agriculture (United Nations, 2015). As the second SDG 2 unifies the aims of agricultural production and improved nutrition, improving the nutritional quality and diversity of crops produced is of paramount importance (Jones and Ejeta, 2016). Previous reviews of the effects of agricultural interventions on nutritional status have demonstrated methodological limitations in generalizing from the current body of evidence, while motivating further analysis (Webb-Girard et al., 2012; Masset et al., 2012). Our work builds on this evidence through a review of the literature on existing programs that aim to improve nutrition by altering household

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agricultural production, inclusive of fish farming and livestock. We create and apply a typology for understanding the livelihood implications of different agriculture-nutrition activities and goals, and their possible pathways to improved nutrition for women and children. We focus on the extent to which agricultural interventions shape, supplement, or replace livelihoods and analyze the context to assess the role of the external environmental and socioeconomic factors in these interventions.

2. Background

Household, or farm-level, agricultural production has been linked with improved household dietary patterns and better nutrition of individual household members (Carletto et al., 2015). A growing body of literature evaluates these linkages and focuses on three of four key pathways linking food production and nutrition: income from agriculture, consumption of a household's own produce, and gender-related factors (Carletto et al., 2015). Work on agricultural and nutrition outcomes demonstrates a link between crop production diversity and dietary diversity (Dillon et al., 2015; Kumar et al., 2015; Malapit et al., 2015; Shively and Sununtnasuk, 2015; Jones, 2015; Sibhatu et al., 2015), and explores the particular role of women's empowerment (Malapit et al., 2015). Livestock ownership also emerges as a factor potentially beneficial for animal source food intake and growth (Azzarri et al., 2015; Hoddinott et al., 2015; Slavchevska, 2015; Rawlins et al., 2014), despite livestock presenting sanitation issues (Azzarri et al., 2015). Calls for a focus on diet quality (McDermott et al., 2015) and evidence that increasing the percentage of dietary energy from non-staples is most effective in improving stunting rates (Smith and Haddad, 2015) further reinforce the importance of dietary diversity in general and animal source foods in particular.

Intervention context, including the impact across global, regional, and local scales of government polices and programs, market dynamics, environmental conditions as well as the immediate factors such as program participation further shape the magnitude of nutritional impacts. For example, market access can influence a household's decision about which crops or livestock to produce (Dillon et al., 2015) or the magnitude of nutritional effects of livestock ownership (Hoddinott et al., 2015). Similarly, climate variability may impact crop diversity and agricultural revenue (Dillon et al., 2015). The gender of intervention participants (Malapit et al., 2015) and the intensity of their engagement (de Brauw et al., 2015) may also influence outcomes.

While a more robust body of evidence now examines correlations between agricultural production and household nutrition (Carletto et al., 2015), evaluations of *interventions* to improve household food production have not yet demonstrated significant impacts on individual's nutritional status (Webb-Girard et al., 2012; Masset et al., 2012; Ruel et al., 2013). There is a great theoretical appeal of food-based programs and their potential for improving nutrition, and there is a strong suggestion that food-based programs could plausibly have effects on nutritional outcomes due to their impacts on intermediate factors associated with nutrition outcomes (e.g. dietary diversity). In spite of these attributes, methodological limitations have largely limited our understanding of the effects of evaluations of household food production interventions to date (Webb-Girard et al., 2012; Masset et al., 2012; Berti et al., 2004; Randolph et al., 2007; Leroy and Frongillo, 2007).

Assessing the consequences of interventions that alter the production patterns and time use of subsistence producers requires appreciating complexities across scales. First, the complexity of the interacting social, ecological, and economic factors shapes the context in which these interventions operate. Second, a diversity of household livelihood strategies position agricultural activities as one piece of a households' complex portfolio. Finally, individuals within the same household may experience sharply different livelihood opportunities and access to food.

To understand the pathways from food production to nutrition we must unpack the domains of "agriculture" and "nutritional status" and the context in which they are embedded (Webb and Kennedy, 2014). Many contextual factors, ranging from political economy to gender to the natural environment, are important determinants of poor child nutrition (Stewart et al. 2013; Smith and Haddad 2015). Closer study of how these factors shape consumption and dietary quality can better illuminate these influences (McDermott et al., 2015). The context in which agriculture-nutrition interventions operate is characterized by the political, social, ecological, and economic conditions that often shape production and consumption, as well as how interventions shift these patterns within livelihoods and households.

A livelihood is similarly complex, and includes people, their capabilities, and the means by which they live, including food, income, and assets (Chambers and Conway, 1991). Five types of capital – physical, financial, social, human, and natural – comprise the 'Sustainable Livelihoods Framework,' which conceptualizes the categories in which livelihoods operate and has a goal of widespread opportunities (Chambers and Conway, 1991; Scoones, 1998). Livelihood strategies may focus on particular types of capital, diversification, or intensification (Scoones, 1998). Integrating the diverse aspects of livelihoods within contextual complexities is particularly valuable in understanding vulnerability, resilience, and coping mechanisms in periods of shocks and stress (Chambers and Conway, 1991). Previous examinations of agricultural interventions in the context of this framework evinced the importance of interventions investing in different types of capital (Berti et al., 2004) and recognizing the diversity of livelihood strategies (Allison and Ellis, 2001).

Households are neither static nor fully cooperative units (Guyer and Peters 1987). Instead, the household is the site of dynamic relations between strategies and resources, and households face changing circumstances in which they make a living (Berry 1984). Household assets may also be shared unequally, with particular constraints on women's access to land, credit, production inputs, technology, and markets (Agarwal 2012). Household food access may not represent individual access; individuals may go hungry in households that are food secure or be well nourished in households that are food insecure (Messer 1997). There may also be gender-biased intra-family food distribution and feeding practices, which would be suggested by higher female than male mortality beginning in childhood (Chen et al. 1981).

In this review, we engage the context in which food production interventions shift patterns of livelihoods and consumption. We summarize the consideration of external factors (e.g. environment, market access) and intervention features (e.g. gender sensitivity, time burden, nutrition counseling) in intervention evaluations. We also develop typologies that elucidate different pathways of impact, nutrition outcomes, and displacement effects and apply them to the interventions reviewed.

3. Methods

To assess agricultural interventions that aim to improve maternal and child nutrition and health, we re-reviewed studies examined in two recent reviews: Masset et al. (2012) and Webb-Girard et al. (2012) and included in our review all articles reviewed that focused on an intervention (n=38 total articles). To capture work published after these reviews, we forward searched all articles citing these and using their search terms, yielding an