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Farm production diversity is associated with greater household dietary diversity in Malawi: Findings from nationally representative data

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ABSTRACT

Farm production diversity has the potential to influence the diversity of household diets, an important nutrition outcome associated with the nutrient adequacy of diets and the nutritional status of individuals. Yet, little empirical research has assessed the relationship between farm diversity and diet diversity or the plausible causal mechanisms that may operate between these two constructs. This research examines cross-sectional data from the Malawi Third Integrated Household Survey (IHS3), a nationally representative sample of farming households in Malawi, implemented from March 2010–March 2011 as part of the World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA). These data were used to determine the relationship between farm production diversity and household dietary diversity, and to identify determinants of this relationship. Two indicators of dietary diversity, a modified Household Dietary Diversity Score (HDDS), and the Food Consumption Score (FCS), were calculated along with three indicators of farm production diversity including the Simpson's Index, a metric accounting for both species richness and evenness. In multiple regression analyses, adjusting standard errors for the complex survey design of the IHS3 and controlling for the effects of several covariates on household dietary diversity, farm production diversity was consistently positively associated with dietary diversity ($P < 0.0001$). The association of increased farm diversity as measured by a combined crop and livestock measure on dietary diversity was significantly greater in woman-headed households compared to those headed by men (HDDS: $P = 0.008$; FCS: $P = 0.076$). The positive association of farm diversity with dietary diversity was also greater in wealthier households ($P < 0.05$). Consumption of legumes, vegetables and fruits was especially strongly associated with greater farm diversity. More diverse production systems may contribute to more diverse household diets. However, this relationship is complex; it may be influenced by gender, wealth, control of household decisions, the relative market-orientation of a household's agricultural production, and the specific nature of farm diversity.

1. Introduction

Agriculture produces much of the world's food, fiber, materials for shelter, and medicinal plants (Hawkes and Ruel, 2006), all of which serve as the primary foundation for sustaining human communities. In particular, for the nearly three-quarters of the world's poor people who live in rural areas of low-income countries, agricultural production and livelihoods may be especially influential on diets (Haddad, 2000; Pinstrup-Andersen, 2007).

Agriculture may influence the quality of diets of smallholder farming households in primarily two ways: (1) through production of subsistence food crops or animals that households then consume directly, or (2) through the sale of agricultural goods that affect household incomes and therefore food purchases and consumption (World Bank, 2007). Other pathways from agriculture to nutrition operate to affect the diets and nutritional status of *individuals* within households—for example: (1) household income may be spent to purchase healthcare for individuals, (2) a woman's time and workload may affect her energy expenditure and health as well as her capacity to feed and care for young children (Jones et al., 2012), and (3) a woman's control of household income, affected in part by her ownership of farm output and the kind of income generated from that output (Kennedy and Cogill, 1987), affects the kinds of purchases made with the income and the allocation of resources within households (Gillespie et al., 2012). Despite the importance of understanding if and how these

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pathways operate to impact nutrition outcomes, surprisingly few empirical studies have examined these relationships. In particular, the relationship between the production diversity of farms and the quality of the diets of the households managing those farms has not been well established.

Agricultural systems have traditionally been measured based on their productivity and economic output. Maximizing yields was the chief aim of Green Revolution technologies that combined high-yielding cereal varieties with the expanded use of fertilizers, chemical inputs and irrigation. While this approach resulted in an unprecedented increase in yields of rice and wheat (Hazell and Ramasamy, 1991), displacing millets and pulses with cereal grain production may have contributed to declines in the nutritional quality of diets (Bamji, 2007; Graham et al., 2007). These yield-driven agricultural systems tend to emphasize production of food energy, fiber and fuel while de-emphasizing production of diverse macro- and micronutrients for human consumption. These emphasized outputs are often produced at the expense of ecosystem services that support and sustain the natural environment (e.g. soil and water conservation, biodiversity or regeneration of organic materials) (World Resources Institute, 2003).

Given the enormous global burden of micronutrient deficiencies borne by vulnerable populations (Micronutrient Initiative, 2009), the seemingly intractable problem of child growth stunting that is in part due to poor quality diets (Bhutta et al., 2008), and emerging trends in overweight and obesity even in rural areas of low-income countries where overnutrition was not previously a concern (Popkin et al., 2011), understanding the capacity of farming systems to meet human nutritional needs is paramount.

One simple, commonly used measure that serves as a proxy for diet quality, or the extent to which nutritional needs are being met, is dietary diversity. Diets with a greater variety of foods or food groups are associated with greater energy and nutrient intakes (Kant, 2004; Rose et al., 2002; Tarini et al., 1999), more adequate nutrient intakes (Hatløy et al., 1998; Steyn et al., 2006), and more positive anthropometric outcomes for adults and children (Arimond and Ruel, 2004; Rah et al., 2010; Ruel and Menon, 2002). Usual household diets in low-income countries are often limited to one or two starchy staple foods and may be especially lacking in micronutrient-rich fruits, vegetables and animal-source foods. For farming households that consume primarily what they themselves produce, it seems reasonable that diversified agricultural production would lead to more diverse diets. However, most farming households throughout the globe in fact practice some mix of subsistence and market-oriented production, thus adding complexity to the relationship between farm production diversity and dietary diversity.

Herforth (2010) examined the relationship between farm diversity and dietary diversity among households in central Kenya and northern Tanzania (Herforth, 2010). In both Kenya and Tanzania, the number of crops grown by a household was positively associated with the dietary variety of the household (i.e. the number of unique foods in the diet) and in Tanzania, crop diversity was associated with the diversity of food groups in household and individual child diets. In both countries, crop diversity was also positively associated with the diversity of home-produced fruits and vegetables consumed. In the rural highlands of Ecuador, on-farm species diversity and family-level dietary diversity were also positively correlated (Oyarzun et al., 2013). Families with low agrobiodiverse farms in this setting consumed more off-farm food items. In western Mali, the number of crops cultivated by a household was positively associated with adult nutrient adequacy (i.e. mean adequacy ratio) (Torheim et al., 2004). Similarly, in rural areas of Malawi, Kenya and Uganda, the richness or diversity of plant species on farms was positively associated with a metric of nutritional functional diversity of farms, or the diversity of nutrients provided by farms based on the nutritional composition of their plant species (Remans et al., 2011). A similar analysis in western Kenya found no relationship between species richness and adult hemoglobin levels, though nutritional functional diversity was positively associated with hemoglobin (DeClerk et al., 2011).

The few studies that have examined the relationship between farm diversity and the diversity or quality of household diets have done so in relatively small population samples. The study presented here seeks to build from the limited evidence to date regarding the association between household farm diversity and household diet diversity by examining cross-sectional data from a large, nationally representative sample of farming households in Malawi. Examining these questions in the context of Sub-Saharan Africa (SSA) is particularly important given the widespread food insecurity and malnutrition seen across the continent, the kinds of agricultural policies currently promoted in response to this poor nutrition, as well as the fact that more than two-thirds of the population depends on agriculture as a source of livelihood (Pinstrup-Andersen, 2010). We use data on the diversity of household cropping systems, livestock production, and diets to determine the relationship between the production diversity of household farms and household dietary diversity, and to identify determinants of this relationship.

2. Methods

2.1 Setting

Malawi is a landlocked country in southeastern Africa of nearly 15 million people bordered by Zambia, Tanzania and Mozambique and to the east by the 587 km long Lake Malawi. The country is divided into 28 districts, located in three regions: north, central and south. Households in Malawi are highly dependent on agriculture. Thirty percent of GDP comes from the agriculture sector (World Bank, 2013a,b) with 94% of rural residents and 38% of urban residents engaged in agriculture to some extent (National Statistical Office Malawi, 2012a). Maize is the main staple for 90% of the population of Malawi, though cassava is also a dominant staple crop with greater than 4 million metric tons produced in 2011 (FAOSTAT, 2013). Almost all agricultural production is rainfed and occurs during the single rainy season from October to April on small plots of land (approximately one hectare) (Denning et al., 2009). In the last decade, maize production has been strongly supported by the Agricultural Input Subsidy Program which provides eligible households with fertilizer and hybrid maize vouchers that reduce fertilizer and seed costs to approximately one-third of the market price (Dorward et al., 2008; Zerfu Gurara and Salami, 2012). While this policy has been effective at increasing national maize production, undernutrition and food insecurity have remained high. Nearly half of all children under five years of age are undernourished (47.1% prevalence of stunting) (National Statistical Office Malawi, 2011) with 60% of preschool-aged children deficient in vitamin A (World Health Organization, 2009) and nearly three-quarters anemic (World Health Organization, 2008).

2.2 Data

We use data from the Malawi Third Integrated Household Survey (IHS3), a nationally representative survey implemented from March 2010–March 2011 as part of the World Bank Living Standards Measurement Study – Integrated Surveys on Agriculture (LSMS-ISA) (World Bank, 2013a,b).

The IHS3 employed a stratified two-stage sample design wherein the primary sampling units were enumeration areas (EA) defined for the 2008 Malawi Population and Housing Census