On-Farm Crop Species Richness Is Associated with Household Diet Diversity and Quality in Subsistence- and Market-Oriented Farming Households in Malawi

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Introduction

Preservation of biodiversity, and particularly agricultural biodiversity, has been recognized as being critical to sustaining productive ecosystems, and has been suggested as a viable strategy to promote adequate human nutrition and food security (1). In sub-Saharan Africa, farm sizes are generally small, have been declining and are expected to continue to decline over the next decades. At the same time, a decline in crop diversity has been observed. In Malawi, for example, this is due to a key agricultural policy to provide subsidies to landowners to bolster maize production (2). The advantage of this strategy may be an increase in productivity and income of farmers. However, producing a single crop may also make farmers with limited land and income less capable to respond to risks from pests, droughts and declining soil fertility (3) and to ensure adequate household nutrition.

The current issue of NNA summarizes a research paper published in the *Journal of Nutrition*. The objectives of the study were to determine associations between agricultural biodiversity and household dietary diversity in Malawi, and to explore mechanisms linking agricultural biodiversity with quality and diversity of household diets (3).

Methods

Data were analyzed from two surveys implemented as part of the World Bank's Living Standards Measurement Study: 1) the 2010-2011 Malawi Third Integrated Household Survey (IHS3), and 2) the 2013 Malawi Integrated Household Panel Survey (IHPS). Both surveys were nationally representative surveys that used a stratified, 2-stage sample design, which included probability proportional to size at the first level (enumeration areas) and random systematic sampling of households within enumeration areas at the second level. Prior to IHPS, a subsample of 768 enumeration areas of the IHS3 were identified for follow up in 2013. Attempts were made to re-visit all IHS3 household within these areas, as well as all individuals who had moved away. The IHPS sample included 4000 households which could be linked to 3104 households in IHS3, considering the splitting of households. The timing of the visits between the two surveys were aligned and the attrition rate was only 3.8%.

In the present analyses by Jones (3), only households that raised ≥1 agricultural crop during the 2012-2013 rainy season and the 2013 dry season were included in the analyses. A total of 3000 households were included, of which 2526 households were original households from IHS3 and 474 newly formed households that split from IHS3 households.

Primary outcomes for the present analyses were household dietary diversity and daily intake of energy, protein, iron, vitamin A and zinc. Nutrient intakes were calculated from the quantity of foods consumed in the 7 days prior to the survey interview, aggregated at the household level for 124 food items. The household dietary diversity score (DDS) was calculated based on 10 food groups, similar to those suggested for the Minimum Dietary Diversity for Women indicator (4). Because the DDS was used as a proxy for micronutrient adequacy, food groups, such as sugar, honey, oils and fats, were not considered in the DDS because they were considered to reflect economic access. However, it has to be noted that sugar is fortified with vitamin A in Malawi and may thus have been an important source for vitamin A intake. For the majority of foods, energy, macronutrient and micronutrient density were estimated from the Tanzanian Food Composition Tables because food composition tables are not available for Malawi. The 7-day household consumption data were converted to daily quantities consumed and were used to calculate daily energy and nutrient intake per adult based on estimated energy requirements for specific sex and age groups (5).

Three indicators of agricultural biodiversity were calculated based on plot-level data on all crops cultivated by households during 2009-2010 and 2012-2013 rainy and dry seasons: 1) crop species richness (CSR; i.e. the number of different crop species represented in a farm), 2) crop varietal richness (i.e. the number of varieties within a crop), and 3) crop nutritional functional richness (this was calculated to correspond directly to the 10 food groups included in DDS because these food groups contribute to the nutritional composition and micronutrient adequacy of diets). Amount of food consumed from own production or purchased were reported and proportions of foods originating from each source were calculated. Socio-demographic characteristics were included in the analyses and standardized asset scores were created from principal component analyses. Adjusted generalized estimating equations were used to assess the longitudinal relation of CSR, crop varietal richness, and crop nutritional functional richness with household diet quality and DDS.

Results and Conclusions

Almost all households were rural in both surveys. All indicators of agricultural biodiversity, and overall amount of harvested crops, proportion of harvested crops sold and monetary value of sold crops were higher in 2012-2013 than in 2010-2011. Following this same trend, mean DDS, and daily intakes per adult equivalent of dietary energy, protein, iron, vitamin A and zinc were higher in the more recent survey. During both surveys, DDS was correlated with daily intakes of energy, protein, iron, vitamin A and zinc ($p<0.001$).

After adjusting for maternal education, household wealth, and other covariates included in the generalized estimating equations, CSR, crop varietal richness, and crop nutritional functional richness were positively associated with DDS in the longitudinal analyses including both surveys. The magnitude of this association was similar for all 3 indicators of agricultural biodiversity. The association between the 3 indicators of agricultural biodiversity and DDS was the most positive for households in the lowest wealth quintiles compared to the highest across all models. Neither the proportion of harvest sold nor the distance between the farm and the nearest population center modified the relation between agricultural biodiversity and DDS. CSR was positively associated with daily intake per adult equivalent of energy, protein, iron, vitamin A and zinc.

Households who produced a certain crop or food, were more likely to report consumption of that food item in the previous 7 days. When examining the association between production of crops or foods and DDS, households who produced beans and peas, nuts and seeds, vitamin A-rich dark green leafy vegetables, other vitamin A-rich vegetables and fruits, or eggs, had greater DDS than households who did not produced these products.

Policy Implications

The present paper found a positive association between household agricultural biodiversity and dietary diversity and quality at the household level. Interestingly, this finding was consistent across households of different production orientation and access to markets, which is likely due to the fact that subsistence farming is very common in Malawi (3). Even farms with greater market orientation still consumed a large proportion of their agricultural products. Nevertheless, across all CSR tertiles, the proportion of purchased foods consumed was 2-3 times greater than the proportion of foods consumed from their own production. Thus, promoting greater agricultural biodiversity and ensuring access to markets with affordable, diverse and healthy foods may be important for a diverse and healthy diet, even in regions with predominant subsistence farming. In an accompanying commentary paper, Fanzo states that the available evidence is mixed on whether market-based solutions or diverse production strategies are better for diets and that both may work but that it depends on context, geography, and farmer priorities (6). Further information at regional and country level are needed to guide future policies to optimize agricultural practices considering economic, environmental, and nutritional needs of smallholder farmers (3).

NNA Editor's Comments

The present paper provided important insights into the relationship between household agricultural diversity and household dietary diversity. In addition to the factors mentioned above, an important consideration when identifying market-based versus agricultural diversity recommendations may be related to sociocultural factors, including gender. Women may have better control over decisions related to sales and consumption of horticultural crops versus staples.

From the methodological perspective, it has to be noted that the 7-day food intake data collected at the household level used to calculate energy, protein, and micronutrient intake is not providing adequate information on individual dietary intake. Thus, the results presented in the paper should be considered proxies of nutrient intake. An interactive 24-hour dietary recall would be required to assess individual nutrient intake or the prevalence of inadequate intakes of different population sub-groups as recommended by Gibson & Ferguson (8).

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