

Decisive Decisions on Production Compared with Market Strategies to Improve Diets in Rural Africa^{1,2}

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Agriculture plays a central role in rural households, where 75% of the world's poor reside and where there is substantial undernutrition consisting of both macro- and micronutrient deficiencies (1). Of the 2.5 billion people in poor countries whose livelihoods depend directly on the agriculture sector, 1.5 billion people live in subsistence, smallholder households (working on ≤ 10 hectares of land). In sub-Saharan Africa, 80% of the food supply for the continent is provided by smallholder farmers, many of whom are women (1).

It is clear that agriculture is the sector best placed to improve food production and access to and consumption of more nutritious foods, and agriculture-led growth has, in some cases, led to observed declines in undernutrition (2). However, most agriculture policies have focused on improving the yield of key staple cereal crops, mainly rice, wheat, and maize, which at the same time has made global food supplies more homogenous (3). This lack of diversity poses public health challenges. Dietary diversity is a vital element of diet quality—the consumption of a variety of foods across and within food groups, and across different varieties of specific foods—and has shown demonstrable gains toward Adequate Intake of essential nutrients and important nonnutrient factors (4–6). Although agriculture can make contributions to healthy diets by increasing and improving diversity of landscapes and the availability of foods produced from those lands, more empirical evidence is needed to better understand the links between agriculture and dietary outcomes (7).

Because many of the poor and undernourished people are smallholder farmers, it is often assumed that diversifying production on their farms would be a logical and direct strategy to improve dietary diversity within the household. Furthermore, increased agricultural biodiversity on those farms would expand the diversity that one could garner from that land for dietary purposes. However, the impact pathways can be indirect and long, and evidence of these linkages is just emerging. There are also limitations when thinking about rural, disconnected, and often neglected areas. Land sizes are small, access to technologies is limited, and markets are often not organized and are geographically distant. Does it make sense for these farmers to diversify their land and attempt to gain all their nutrient needs from that land, or would it be better for farmers to invest in

monoculture and cash crops, and use the generated income from the sale of those crops to purchase more nutritious foods?

Several studies have attempted to better understand the linkages between smallholder farmer production and what that means for dietary diversity. Examining household-level data from Indonesia, Kenya, Ethiopia, and Malawi, Sibhatu et al. (8) found that on-farm production diversity was positively associated with dietary diversity; however, market transactions had stronger correlations. In cases in which food production diversity was high, there was no significant association with dietary diversity, because specialization of cash crops had more income benefits than direct consumption benefits. The authors argued that increasing on-farm diversity was not always the most effective way to improve dietary diversity in smallholder households. In a study with similar results that used 24-h recall data collected over 12 mo from smallholder farm households in Malawi, researchers found that farm production diversity had a small, positive association with dietary diversity. However, access to markets had stronger positive associations with improved dietary diversity (9).

The type of agricultural biodiversity of species grown on farms may also matter for dietary diversity improvements. With the use of a metric termed Nutritional Functional Diversity (NFD) that, to my knowledge, is novel, 2 studies had interesting findings. The NFD metric is based on plant species composition on the farm and the nutritional composition of those plants. The metric captures the diversity of nutrients on farm landscapes. The first study demonstrated no significant correlations at the farm level between the NFD of the crops grown and household dietary diversity in rural Malawi, Kenya, and Uganda. There was, however, a significant association found between the number of foods bought and sold at local markets, with only 50% of the food consumed produced from their farms, further emphasizing the importance of local markets (10). The second study, which used nationally representative household consumption data in Malawi, found that the NFD varied depending on the context, particularly the geographic location. Purchased foods contributed more to household dietary diversity than did foods produced at home. Households further from markets had lower overall diversity and accessed relatively more of their diversity from home production than did households closer to markets (11).

In an article published in this issue of *The Journal of Nutrition*, Jones (12) determined whether agricultural biodiversity on smallholder farms translated to increased dietary diversity and quality

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in the sub-Saharan Africa context, and, if so, whether through direct food production pathways or through market pathways. With the use of nationally representative household surveys in Malawi collected between 2010 and 2013, 7-d dietary diversity scores were calculated, along with crop species richness (CSR) from plot-level data on all crops grown from 2009 to 2013. Jones found that CSR was positively associated with dietary diversity and the intake of key nutrients. Interestingly, distance to markets did not alter the relation between CSR and household diet diversity. Jones argued that on-farm diversity is an important benefit to improving dietary diversity and quality and provides a potential income generation mechanism to sell those foods in local markets. The article is important because it does not just look at contributions of smallholder farmer production to diets, but also the richness in diversity of those production systems. It also validates a new way to conceptualize agricultural biodiversity in relation to diets with the use of 3 measures: 1) CSR, 2) crop varietal richness, and 3) crop nutritional functional richness. There is a great need for more metrics that measure the associations of production diversity on potential dietary quality, and this article provides unique insights with the use of metrics that originate from the ecology literature.

Our ability to assess whether agriculture is producing and providing the best balance of foods, or whether populations are consuming recommended dietary patterns, has been limited (13); however, in the last few years, more empirical evidence has been emerging. The study by Jones (12) adds a new context to this empirical evidence for rural Africa; however, research questions remain. First, we need more studies similar to that conducted by Jones that have rigorous designs (with robust power, sample sizes, and analytic objectivity), methods, and metrics to assess the impact of household food production strategies on biological and dietary indicators of nutrition (14). For example, information on food consumption from household-level dietary surveys is limited or is of poor quality, resulting in an inability to assess the impact of changing agricultural practices or policies on dietary intake patterns. Second, we have to remember that these smallholder farms do not sit in isolation. The relation between production and consumption diversity needs to be considered at spatial scales beyond households, including subnational scales capturing the landscape level (15). Third, there are substantial trade-offs for farmers in their farming decisions. Economic outcomes are a priority, but so are nutrition, ecosystem, and social outcomes. Farming is a difficult business to engage in, especially now, with serious threats to livelihoods including climate change, urbanization, and population pressure. Many farmers are diversifying their employment portfolio, and income streams will come from multiple sources. This makes the research in understanding production to diet pathways all the more complex, yet important.

Evidence is emerging but mixed. Although the question remains whether market-based solutions or diverse production strategies are better for diets, the evidence suggests that both can work, but they depend on context, geography, and farmer priorities. The article by Jones makes an important contribution to the empirical evidence that demonstrates the linkages between agricultural production diversity, market access, land size cultivation, and consumption diversity, particularly among the

poorest households. In the rural Malawi context, agricultural biodiversity, which sadly is a natural resource in rapid decline, makes a difference in dietary quality.

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