LETTER

Expanding the view on the production and dietary diversity link: Scale, function, and change over time

Sibhatu et al. (1) elegantly show how access to markets influences the relationship between production and consumption diversity at the household level. This confirms similar findings from other recent studies (2) but lacks discussion of three major points: (*i*) landscape diversity and local markets, (*ii*) multifunctionality of diversity, and (*iii*) remote settings.

Regarding landscape diversity and local markets, we strongly agree that not every individual farm should increase production diversity, but argue that the relationship between production and consumption diversity needs to be considered at spatial scales beyond households, including subnational scales (e.g., landscape, district). When entire landscapes transition to intensified commercial agriculture, there is risk, particularly in low-income settings, for markets to export nutritious and cash products and mainly import highly processed, easy transportable products that contribute to undesirable nutrition transitions (3). Although farmer specialization can foster transitions out of poverty and strengthen local markets, the effects of landscape specialization on food environment and consumption patterns are much less studied. United States rural food deserts, with low access to fresh, nutritious foods, overlap with highly intensified agriculture areas (4). From our perspective, the crux of the question between production and consumption diversity sits not at household level, but at how understanding this relationship at multiple scales can guide diversity management in transitioning food systems toward healthy, equitable, and sustainable food environments.

In terms of multifunctionality of diversity, Sibhatu et al. (1) briefly note the importance of environmental benefits of agricultural diversity. However, their focus on market-based approaches to securing dietary diversity potentially undermines the role of agricultural diversity in supporting sustainability of agricultural and food systems. Agro-ecological research demonstrates that systems diversity can stimulate long-term productivity, stability, ecosystem services to and from agricultural lands, and resilience to shocks (e.g., pests and diseases, climate, or price shocks) (5). Trade-offs between maintaining diversity at the field, landscape, or national scale for nutritional, economic, and environmental outcomes, therefore need careful consideration in food-system recommendations.

In terms of remote settings, strengthening market access is easier said than done, particularly for remote, isolated settings and farms. Luckett et al. (2) showed that isolated farms in Malawi have the lowest nutritional functional diversity and are regions where market-driven solutions are least likely, at least over the short term. This same study showed that proximity to extension services in remote locations had significant impacts on increasing nutritional diversity of production systems and diets. Understanding food-system diversity should help target interventions to specific contexts: production or market-based, or a combination. Identifying which food group or functional group is missing from a whole-diet perspective, and strengthening capacity through extension services, is a complementary and sometimes faster route than market integration for increasing dietary diversity of isolated rural households or communities.

In conclusion, we highlight these three considerations in the hopes of enriching the important scientific and developmental discussion on the relation between production and consumption diversity and their impacts on human and environmental health.

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1 Sibhatu KT, Krishna VV, Qaim M (2015) Production diversity and dietary diversity in smallholder farm households. *Proc Natl Acad Sci USA* 112(34):10657–10662.

2 Luckett BG, DeClerck FA, Fanzo J, Mundorf AR, Rose D (2015) Application of the Nutrition Functional Diversity indicator to assess food system contributions to dietary diversity and sustainable diets of Malawian households. *Public Health Nutr* 18(13):2479–2487.

3 Tschirley D, Reardon T, Dolislager M, Snyder T (2014) *The Rise of a Middle Class in East and Southern Africa. Implications for Food System Transformation*. WIDER Working Paper 2014/119. Available at fsg.afre.msu.edu/fsp/WIDER_Tshirley_Reardon_Dolislager_Snyder_Africa_middle_class_rise.pdf. Accessed September 18, 2015.

4 Dutko P, Ver Ploeg M, Farrigan T (2012) *Characteristics and Influential Factors of Food Deserts* (US Department of Agriculture, Economic Research Service, Washington, DC), ERR-1401. Available at www.ers.usda.gov/media/883903/err140.pdf. Accessed September 18, 2015.

5 Wood S, et al. (2015) Functional traits in agriculture: Agrobiodiversity and ecosystem services. *TREE* 30(9):531–539.

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