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INNOVATION LAB FOR FOOD SECURITY POLICY RESEARCH, CAPACITY, AND INFLUENCE

Crop Production Diversity and the Well-being of Smallholder Farm Households in Nigeria

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Introduction

Growing more than one crop species at a time is a common production strategy observed among smallholder farmers throughout sub-Saharan Africa, including Nigeria (Isbell et al., 2021). More than four out of five farming households in Nigeria practice crop diversification (CD). Smallholder farm households (cultivate ≤ 5ha) are even more likely to practice CD, as they cultivate about three crop species on average and more than 9 out of 10 grow more than one crop (LSMS waves 1-3). CD involves the simultaneous cultivation of a variety of crop species that suit local conditions. It serves as a strategy to mitigate and cope with both socioeconomic and environmental shocks and risks (Labeyrie et al., 2021). CD does not only foster cooperation among crops, it also lowers the risk of pest and disease outbreaks caused by climate variability. Furthermore, it reduces farmers' vulnerability to crop failure when relying on one crop species.

CD contributes to more diverse diets for households, especially in settings where the food produced is for home consumption (Debela et al., 2021). Thus, CD may enhance household food consumption by increasing both the quantity (calories) and variety of food consumed. However, the effect of production diversity on dietary diversity may weaken and even disappear for households with access to food markets (Hirvonen and Hoddinott, 2017). This is because, market access allows farming households to separate their production decisions from their consumption decisions, so they can focus on maximizing farm profit and then enjoying healthy varied diets through food purchases (Khonje et al., 2022).

Key Facts

- **Many (85%) farming households in Nigeria practice crop diversification.**
- **CD is associated with more diverse diet: the association is larger for households farther from a market.**
- **Households' consumption and farm profit increases with CD.**
- **Households are more likely to diversify production when faced with positive rainfall shocks.**

Although we cannot conclude on the extent of the effect of practicing CD on household well-being, because even when the associations between CD and the quality of household diets is positive, households may need to grow nine additional crops to increase the number of food groups consumed by one (Sibhatu and Qaim, 2018b). The associations are often insignificant when CD is measured by crop group rather than species count (Sibhatu and Qaim, 2018a). Besides, crop diversity may even "entrench poverty" by limiting household specialization and profit maximization, even when there is a valid reason for engaging in CD (Appiah-Twumasi and Asale, 2022). Likewise, households that embrace CD may encounter income losses due to poor production pattern choices (Kiani et al., 2021). Thus, there's still debate as to whether CD contributes to improved household well-being, motivating the need to better understand the channels through which crop diversity can improve households' dietary diversity.

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Research Aim, Methods, and Data

This research addresses the following question using Nigeria's Living Standard Measurement Survey (LSMS) nationally representative data for 2010/2011, 2012/2013 and 2015/2016: **What is the relationship between CD and household welfare? where the latter is measured by household per capita consumption expenditures (PCE), household dietary diversity (HDD), and household food consumption scores (FCS**)? Additionally, we explore the factors influencing CD practices, and the impact of CD on farm profits. Greater insight into how farmers manage and adjust to shocks is important for developing evidence-based policy responses and actions to enhance food and livelihood security.

We measure CD as the number of crop groups (based on a 7-crop group classification - cereals, legumes/pulses, tubers, vegetables, fruits, tree crops, and cotton) and crop species (number of varieties of crops planted) grown, and we find that households cultivate two crop groups and just over three crop species on the average between 2010 and 2016. There is a slight variation in the level of CD over the period. The average number of crop species rose from 3.1 in 2010 to about 3.3 in 2016. Meanwhile, households growing one crop group reduced from 28% to 25% over the same period. Household consumption expenditure decreased over the period during the post-harvest season but increased in the post planting season. Likewise, FCS slightly decreased over the period while there was a slight increase in HDD over the period with households consuming about 6 food groups and having an average food consumption score of 23. The post-harvest (February to April) and post planting (August to October) variation shows the importance of seasonality in the condition of household welfare while the FCS reveals that most households are classified as borderline food secure (i.e., between 21-35 based on classification of the World Food Programme (2008)). Additionally, HDD is higher (more diverse) during post planting than in the post-harvest season, whereas household consumption expenditures and FCS are lower (consume less) in post planting than in the postharvest season.

Results

We find that for households with limited access to markets, crop-production diversity is positively associated with household well-being, especially with the quality of household diets, though the associations are small. For example, for households residing 64km from markets (50th percentile), growing an extra crop is associated with only 0.04 additional food groups consumed by the household (HDD) on average. While we find no evidence that CD is associated with more diverse diets (HDD and FCS) in communities adjacent to markets (consistent with the notion that households with market access can treat their production and consumption decisions separately), households that are farther from markets appear to rely in part on the diversity of the crops that they produce for diversity in their diets. This is illustrated in Table 1 by the positive and statistically significant marginal effects of CD on HDD and FCS at the 25th, 50th, and 75th percentiles of distance to markets. Again however, these associations are small. The result is mixed for the association between CD and household expenditures. For example, there appears to be a positive relationship between CD and household per capita expenditures in communities with limited access to markets during the post-planting season. Yet those households with limited market access that produce a greater variety of crop groups tend to have lower per capita expenditure levels in the post-harvest season.

Table 1: Association between CD and Household Welfare

	Post planting			Post harvest		
	lnPCE	**HDD**	**FCS**	**lnPCE**	**HDD**	**FCS**
Crop diversity (*CD*)	0.012	0.075	0.816	0.109***	0.099	0.227
Marginal effect of CD						
- evaluated at 25th percentile from market	0.030**	0.112***	1.087***	-0.020	0.047**	0.263
- evaluated at 50th percentile from market	0.037***	0.120***	1.180***	-0.045***	0.037*	0.328*
- evaluated at 75th percentile from market	0.46***	0.120***	1.273***	-0.038**	0.043	0.484**
Controls	Yes	Yes	Yes	Yes	Yes	Yes
Number of observations	7,481	7,467	7,467	7,480	7,475	7,475

Note: Statistical significance denoted at ***p < 0.01, **p < 0.05, *p < 0.1. Natural log of per capita expenditure, Household Dietary Diversity, and Food Consumption Score are denoted by lnPCE, HDD and FCS, respectively.
Source: Authors' calculation from the 2010 – 2015 LSMS Nigeria Data.

Considering the factors influencing the number of crop groups grown (Table 2), we find no evidence that drier than normal conditions (negative rainfall deviation) influence the number of crop groups that farmers grow. We do, however, find that households that experience more rain than normal (positive rainfall deviation), tend to grow more crop groups. On average, households that experience 10 millimeters more rain than the long-term average rainfall grow one more crop group, which is reasonable given that when crops groups are planted together, they may be introduced sequentially during a 2–3-month time period. There is a nonlinear relationship between market access and CD. For households within 64km of markets, we find that the number of crop groups grown by households increases with distance from the market but does so at a decreasing rate. Beyond 64km, the number of crop groups grown tends to decrease for households that are even further away. Lastly turning to the correlates of farm profits (Table 3), we find that households that produce more crop groups tend to have higher farm profits. For example, an additional crop group grown is associated with 16% higher household farm profits on average. We also find that households that experience abnormally dry weather tend to have lower farm profits, while those experiencing more rainfall than normal tend to have higher profits. These results suggest that farm profits may be one of the pathways through which CD influences household per capita consumption positively during the post-planting period.

Table 2: Factors Affecting Uptake of CD

Variables	CD
Marginal effect of rainfall shock	
- Negative rainfall deviation	0.006
- Positive rainfall deviation	0.119***
Marginal effect of distance to market	
- evaluated at 25th percentile	0.002***
- evaluated at 50th percentile	0.000
- evaluated at 75th percentile	-0.002***
Controls included	Yes
Number of observations	7,481
F	34.63
Prob>F	0.00
R-Squared	0.11

Table 3: Association between CD and Farm Profit

Variables	Farm Profit
Crop Diversity (CD)	0.161***
Marginal effect of rainfall shock	
- Negative rainfall deviation	-0.368***
- Positive rainfall deviation	0.628***
Marginal effect of distance to market	
- evaluated at 25th percentile	0.026**
- evaluated at 50th percentile	0.017*
- evaluated at 75th percentile	0.004
Controls included	Yes
Number of observations	5,826
F	7.26
Prob > F	0.00

Note: Statistical significance denoted at ***p < 0.01, **p < 0.05, *p < 0.1. 25th, 50th and 75 percentiles from market are at 43km, 64km and 95km, respectively.
Source: Authors' calculation from the 2010 – 2015 LSMS Nigeria Data.

Policy Implications

An understanding of the pathways through which CD affects household well-being and the factors influencing CD uptake is important for policy making in Nigeria and most sub-Saharan African countries. The simultaneous growing of more than one crop species is an important production strategy commonly employed by a majority of smallholder farmers. Although these farmers are responsible for the bulk of food production in the region, they rely on rainfed agriculture which makes them vulnerable to rainfall shocks and be at risk of food insecurity. We find positive association between CD and quality of household diets, especially for households with limited market access; and a higher impact of positive rainfall shocks on CD as compared to negative rainfall shocks. Based on these, we draw the following policy recommendations:

Promoting CD: CD is a key option to be encouraged amongst farmers, especially resource poor farmers, when faced with positive shocks and/or with poor access to food market. The federal and state ministries of agriculture through the extension agents should encourage uptake of CD strategy amongst farmers that have no or poor access to food market and those most vulnerable to rainfall shocks. This will conversely enhance their well-being in terms of the quality and dietary diversity.

Capacity building: Policy makers should channel adequate funding towards enhancing the capacity of farmers through increased access to extension services and trainings to know the right combination of crops to plant and optimal number of species, as this may stimulate their adaptive capacity and profit.

Market access: Given the importance of the positive association between CD and farm profits, CD that is market-oriented has a stronger positive effect on household dietary diversity as compared to CD that is more subsistence-oriented. With the high proliferation of subsistence farming in Nigeria, enhancing production diversity through market access is a promising development strategy. Hence, governments should work to improve market access for smallholder households through access to improved infrastructure and market information, which can encourage more rational choices on crop diversification and promote optimal gains, potentially through specialization.

Future research: Deeper insight into the interaction between CD and shocks is also important for designing intervention programs aimed at stimulating the adaptive capacity of farmers to cope with extreme weather events and garner support from the government through early warning information and inputs. As we need stronger evidence of the positive association between CD and farm profit as well as between CD and household consumption levels, because these positive associations suggest that CD can be an effective risk management strategy that does not come at the expense of profit generation.

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Authors

Ibukun James Olaoye is a Postdoctoral Research Fellow in the Department of Agriculture and Food Policy, Nigerian Institute of Social and Economic Research, Ibadan, Nigeria.

Sarah Edore Edewor is a Postdoctoral Research Fellow in the Department of Agriculture and Food Policy, Nigerian Institute of Social and Economic Research, Ibadan, Nigeria.

Tarana Chauhan is a PhD candidate at Cornell University.

David Stifel is a Professor at the Department of Economics, Lafayette College.

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