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Synopsis: The role of the locations of public sector varietal development activities on agricultural productivity

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RESEARCH OVERVIEW

Despite the importance of location-specific adaptive crop breeding research, past reforms of breeding systems in Nigeria have focused on centralizing breeding activities into fewer locations. This has been based partly on the premise that such research systems can still effectively meet the need for a diverse set of crop varieties suited for different agroecological conditions by using numerous outstations and multilocational trials. However, little empirical evidence exists to support this premise.

Using panel data from farm households in northern Nigeria and spatial data on agroecological factors, this study shows that crop productivity and technical efficiency at farm household level is positively affected by the degree of similarity between the agroecological conditions of the locations of these households and where major crop breeding institutes are headquartered. Where improved varieties are developed affects crop productivity in different locations.[1]

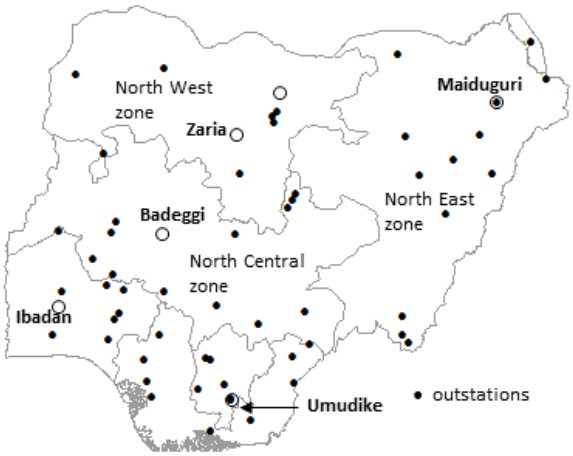
Crop productivity in Nigeria can be significantly increased by expanding support for crop varietal development in a manner that increases the similarity in agroecological conditions between the locations where crop breeding is conducted and the areas where farmers produce those crops. Increased centralization of crop breeding will reduce, rather than increase, crop productivity.

BACKGROUND

The performance of improved crop varieties varies across space depending on agroecological conditions. A greater degree of similarity in conditions between the locations where new varieties are developed and where farmers use them (agroecological similarity, hereafter), can be expected to improve crop productivity on farmers' fields.

In attempting to raise efficiency in agricultural research and development, Nigeria has increasingly centralized its crop breeding systems. Nigeria has significant heterogeneity in agroecological conditions, yet crop breeding activities now are relatively concentrated in a handful of institutes (Figure 1).

Figure 1: Major crop breeding institutes and outstations in Nigeria



Crop varietal development in Nigeria is primarily conducted by the public sector. Consequently, most improved crop varieties have been released by a relatively small number of institutes (Table 1) The six major crop breeding institutes – Maiduguri, Kano, Zaria, Badeggi, Ibadan and Umudike – account for 90 percent of all improved varieties released in Nigeria.

This concentration in the locations where improved crop varieties were developed may magnify variation in productivity across locations where the crop is grown. The reduction in agroecological similarity for the crop varieties between where they were developed and where

[1] A detailed discussion of this research can be found in NSSP Working Paper 42, *The role of the locations of public sector varietal development activities on agricultural productivity: Evidence from northern Nigeria.* http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/131355

Table 1. Concentration in locations of released improved crop varieties in Nigeria

Crop	No. of varie-ties	From six major breeding institu-tions, %	Crop	No. of varie-ties	From six major breeding institu-tions, %
Cassava	54	94.4	Rice	110	98.2
Cotton	13	100.0	Sorghum	57	87.7
Cowpea	44	93.2	Sugarcane	20	45.0
Soybean	31	96.8	Tomato	17	76.5
Groundnut	32	90.6	Wheat	17	100.0
Maize	155	94.2	Yam	26	100.0
Pearl millet	13	100.0	Other crops	123	77.2
			Total	**712**	**90.0**

Source: Authors' calculations.
The six major breeding institutions are Maiduguri, Kano, Zaria, Badeggi, Ibadan, and Umudike.

farmers plant them over substantial parts of the country may reduce crop productivity levels. Indeed, yields of important crops in Nigeria have stagnated at among the lowest levels in the world. Improved crop breeding systems could significantly accelerate crop productivity growth.

RESEARCH APPROACH AND RESULTS

We use data from the Nigeria LSMS-ISA for 1,953 farm households in the survey sample from the northern part of Nigeria. This data was collected over three waves in 2010/11, 2012/13, and 2015/16. An agroecological similarity index was constructed for each farm household and the crop breeding institutions based on their locations using three types of spatial data for Nigeria:

- Climate: annual rainfall, wind speed, solar radiation;
- Soil-related: cation exchange capacity, acidity, texture, organic carbon content, bulk density;
- Topography: terrain ruggedness, slope

The measures of agricultural productivity and technical efficiency for each farm household were based on their total factor productivity.

Table 2 summarizes the estimated effects of agroecological similarity on households' crop productivity or technical efficiency as elasticities.

Table 2. Elasticities of crop productivity and technical efficiency with respect to change in agroecological similarity between farm and crop breeding locations

Agroecological similarity indicator used	Product-ivity	Efficiency
Average similarity with all six main breeding institutes	1.255** (.581)	1.190* (.615)
Average similarity with all outstations of breeding institutes	1.541** (.636)	1.620** (.647)

Source: Authors' calculations. Asterisks indicate statistical significance: *** 1%; ** 5%; * 10%. Numbers in parentheses are standard errors, are estimated through 200 bootstraps.

For example, 1.255 suggests that increasing the agroecological similarity between where a crop variety was developed and where a farmer plants it by one percent will leads to a 1.255 percent increase in the crop productivity measure.

Table 2 suggests that the effects of agroecological similarity between where crops were developed and the locations where they are planted by farmers on agricultural productivity and technical efficiency is significantly positive. Moreover, this finding is robust across different similarity indicators.

CONCLUSIONS

These results suggest that where improved crop varieties are developed and evaluated affects crop productivity and technical efficiency on farms in different locations where those varieties are planted. The current structure of crop breeding systems in Nigeria does not overcome the diversity in agroecological conditions across the country.

Diversity in the locations of research institutes conducting crop breeding and varietal development matters for overall crop productivity and technical efficiency in Nigeria. It is, however, impractical to expect substantial crop productivity improvement by simply decentralizing breeding research into more locations. Rather, these findings should be interpreted as complementary to efforts promoting increased overall resource flows to agricultural research and development in Nigeria.

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