



Take-up and Demand for a Bundle of Biofortified Seeds and Agricultural Inputs in Northeastern Nigeria

Mulubrhan Amare, Kate Ambler, Temilolu Bamiwuye, Jeffrey Bloem, Rewa Misra, and Julia Wagner

Smallholder farmers in northeastern Nigeria face interrelated challenges of food insecurity, climate volatility, and conflict. Northeastern Nigeria has some of the highest levels of food insecurity in Nigeria (UNICEF, 2023), and more volatile rainy seasons have led to massive floods, depleted soil quality, and disrupted agricultural growing seasons. The changing climate, therefore, presents challenges for improving agricultural productivity and addressing food insecurity. Additionally, millions in the region have fled their homes due to conflict between pastoralist livestock herders and settled agricultural communities over land use and extremism (International Crisis Group, 2023; McGuirk and Nunn, 2023). Exposure to conflict itself contributes to reduced agricultural production (Adelaja and George, 2019) and increased food insecurity (George et al., 2020). Studies also indicate a decade-long increase in conflict levels, where poverty is associated with sustained conflicts. Northeast Nigeria is notably affected, with 49 percent of households experiencing conflict between 2010 and 2017 (Azad et al., 2018).

Moreover, the desertification and depletion of soil quality results in a cycle of low agricultural yields, nutrition deficiencies, and adverse health effects associated with poor food micronutrient quality. As a result, Northeastern Nigeria suffers from high levels of anemia and zinc deficiency which can together adversely affect both cognitive and physical development as well as immunity (NPC and ICF, 2019). A key hurdle to addressing these challenges is that farmers tend to not simultaneously adopt an appropriate mix of improved agricultural technologies, choosing instead to either expand area under cultivation or invest in discrete inputs that are more affordable—such as improved seed or specific pesticides—and rarely applying these inputs together on the same plot (Christiaensen, 2017)

In this project note, we present results from an ongoing randomized control trial that aims to address these interrelated challenges by promoting the purchase of a bundle of agricultural inputs, including: biofortified seeds, fertilizer, crop protection products, and insurance among smallholder farmers in Gombe state, Nigeria. This bundle is designed to leverage agro-ecological complementarities that are critical for optimal crop production and well-suited for the agricultural conditions of Northeastern Nigeria.

Experimental Design

The objective of this analysis is to assess take-up and smallholder farmer demand for these agricultural inputs marketed as a bundle using a cluster randomized control trial. Additional downstream effects on production and household welfare will be assessed through a post-harvest survey to be conducted in late 2024. We implemented our study in the following five local government areas (LGAs), which were selected based on their relatively high concentration of internally displaced people: Akko, Dukku, Yamaltu-Deba, Kaltungo, and Kwami.

The intervention provides marketing information, makes the bundle of biofortified seeds and other agricultural inputs readily available to smallholder farmers in our study sample, and distributes two levels of discount vouchers. The bundle is supplied by Premier Seeds, a local agricultural input supply company, and distributed through their network of agro-dealers. Farmers are randomly assigned into one of four treatment groups at the community level:

1. Control: No marketing information or discount vouchers
2. Treatment 1: Marketing information only
3. Treatment 2: Marketing information + 50% discount vouchers
4. Treatment 3: Marketing information + 75% discount vouchers

In the control group, there is no specific availability and no marketing activities. In treatment group 1 the bundle is promoted in the community through extension agents and the farmers in our study sample receive a marketing visit and text messages providing them with information about the bundle. These components of the intervention address critical constraints on the supply of improved technologies to smallholder farmers and on the existing knowledge about biofortified seeds among the farmers in our study sample.

The bundle itself costs between 74 and 84 USD, about 120,000 Naira, which might limit adoption by liquidity-constrained or risk-averse smallholder farmers. Therefore, in treatment groups 2 and 3, we provide vouchers for a discount on the agricultural input bundle of either 50 percent or 75 percent respectively. We chose these discount levels to be around the discounts provided in other studies in this literature (see, e.g., Carter et al. 2021) and to ensure sufficient variation in the discount levels.

Comparing take-up indicators between farmers in control villages and farmers in treatment group 1 reveals the effect of providing access to the supply of these agricultural input bundles and the marketing information. Comparing take-up indicators within treatment groups between farmers who received and did not receive a discount voucher reveals the effect of providing a discount voucher and allows us to estimate the demand for these agricultural input bundles at varying prices.

A key source of heterogeneity in our analysis is to assess differential effects between internally displaced people and pre-existing residents. Therefore, we will specifically examine the research questions discussed above among the sub-set of our data that are internally displaced people and the sub-set of our data that are pre-existing residents of Gombe state, Nigeria.

The Bundle

The bundle includes the following nine components. Three varieties of biofortified seeds:

1. 2 kgs of pearl millet seeds

2. 6 kgs of cowpea seeds
3. 5 kgs of vitamin A maize seeds.

Each of these seed varieties are well tested for the agro-ecology of Gombe state, Nigeria. Additionally, these seeds are drought tolerant, disease resistant, high yielding, early maturing, and provide relatively high amounts of iron and zinc. The bundle also includes two types of fertilizer:

4. 50 kgs of NPK fertilizer
5. 50 kgs of urea fertilizer

The bundle also includes three crop protection products (i.e., weedicide, pesticide, and herbicides):

6. one liter of cypermethrin
7. one liter of pendimethalin
8. three sachets of seed dressing.

The ninth and final component of the bundle is insurance. Insurance payouts are triggered in the event of insufficient rainfall. Enrollment in this insurance coverage is automatic and included with the purchase of the bundle.

The bundle, named “Tushan Arkizi” meaning “bundle of good fortune,” is applicable for a quarter hectare plot and sold in partnership with Premier Seeds. Premier Seeds is an agricultural input company with a multinational presence in Africa and can directly distribute products through its network of depots and agro-dealers in our study areas.

Sample Characteristics

Our sample includes 2,300 farmers from 230 communities across five LGAs in Gombe state, Nigeria. Our sampling approach first selected communities within the five LGAs. We then conducted a listing of all farmers within the community and randomly selected ten farmers from these lists to generate our study sample. We collected baseline data in November 2023.

In Misra et al. (2023) we presented descriptive statistics about our sample collected at baseline. Approximately 84 percent of the farmers in our study sample live in rural communities. The average age of household heads, and consequently the primary respondents, is 43 years old. The majority, 94 percent, of households are headed by a male. Islam is the predominant religion among respondents. We define internal displacement as having occurred if a farmer reported relocation of their household at some point in the past. Based on this definition, we classify 17 percent of farmers in our data as internally displaced people (IDP). Close to half of the households indicate ownership or cultivation of at least one irrigated plot. Analysis of crop cultivation patterns reveals that cowpea is the most commonly grown crop, with almost 90 percent of farmers cultivating it on at least one plot in the last dry and/or wet season. Other prevalent crops, cultivated by over half of the households, include sorghum, millet, rice, and maize.

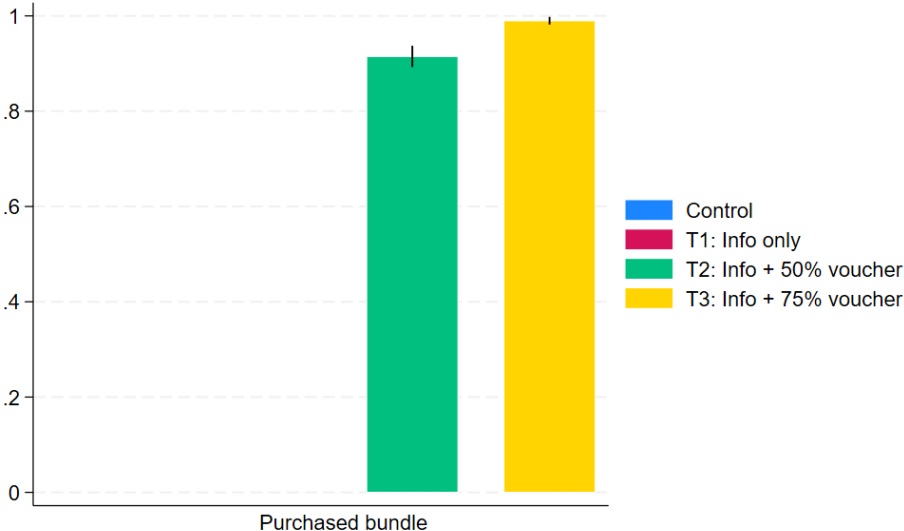
Take-up Analysis

Throughout the implementation of this study, we collected data on bundle purchases among farmers in our sample via reports from the agro-dealers selling our bundle. Using this data, we can document preliminary take-up results and describe the demand for this bundle of biofortified seeds and other agricultural inputs among the farmers in our study sample.

Figure 1 plots the take-up rates by treatment status. Zero farmers from either the control group or treatment group 1, receiving only the marketing information, purchased the bundle during the study period. This can largely be attributed to price volatility in agricultural inputs—especially fertilizer—during the implementation of our study. Shortly after our study began, the prevailing market price of the components in the bundle fell by 10 percent. Additionally, in mid-June the Gombe state Governor [passed a policy](#) that provided a 50 percent subsidy on the purchase of a 50kg bag of NPK fertilizer—this further reduced the market price of the components in the bundle by an additional 15 percent. This led to the price of the bundles marketed to farmers in treatment group 1 to be higher than the prevailing market price and discouraged them from purchasing the bundle throughout the study period.

By contrast, in treatment groups 2 and 3, where farmers received a discount voucher, the price of the bundle with these discounts applied was sufficiently lower than the prevailing market price for each of the inputs purchased separately. In both treatment groups 2 and 3, over nine out of every ten farmers purchased the bundle during the timeframe of our study. Specifically, 92 percent of farmers in treatment group 2 and 99 percent of farmers in treatment group 3 purchased the bundle.

Figure 1: Bundle Take-up by Treatment Status



To further assess the differences in the take-up rates between each of the treatment groups, we conduct and present regression analysis in Table 1. The coefficients in column (1) of Table 1 replicate the results presented graphically in Figure 1, but this regression analysis allows us to test whether each of the coefficients, specifically the coefficients on T2 and T3, are statistically different from each other. Column (1) of Table 1 shows that although the take up rates in T2 and T3 are both above 90 percent, the 7.5 percentage point difference between these coefficients is statistically significant. This demonstrates that the level of the discount voucher, rather than just the receipt of any discount, influences the take-up rate of the bundle. Another key detail from column (1) is that a simple regression with binary variables indicating treatment group status explains 91 percent of the variation in take-up in our data. This highlights the importance of price in determining take-up among farmers in our sample.

In columns (2) and (3) of Table 1, we analyze take-up separately for farmers categorized as IDPs and farmers categorized not as IDPs but instead as pre-existing residents. As shown in Misra et al. (2023) and noted above, we only categorize about 17 percent of the farmers in our sample as IDPs. Thus, the

sample in column (2), which restricts our sample to only farmers categorized as IDPs, includes 380 farmers. Despite the small sample size, we find qualitatively similar results in column (2). Specifically, 93 percent of farmers categorized as IDPs in treatment group 2 purchased the bundle, compared to 98 percent in treatment group 3. The gap in take-up between farmers categorized as IDPs in treatment groups 2 and 3 is slightly smaller, at just over 5 percentage points, and we cannot reject the hypothesis that these two coefficients are equal. In column (3), where we restrict our sample to farmers who we categorize as pre-existing residents, we again find qualitatively similar results. 91 percent of farmers that categorized as pre-existing residents in treatment group 2 purchased the bundle, while 99 percent in treatment group 3 did so. The eight percentage point gap in take-up rates between farmers categorized as pre-existing residents in treatment groups 2 and 3 is statistically significant.

Table 1: Regression Analysis

Outcome variable:	(1)	(2)	(3)
Purchased bundle	Full sample	IDPs	Pre-existing residents
T1: Info only	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)
T2: Info + 50% voucher	0.915*** (0.024)	0.925*** (0.044)	0.913*** (0.026)
T3: Info + 75% voucher	0.990*** (0.005)	0.978*** (0.015)	0.992*** (0.04)
T1 = T2? (p-value)	0.000	0.000	0.000
T1 = T3? (p-value)	0.000	0.000	0.000
T2 = T3? (p-value)	0.002	0.258	0.004
Observations	2,300	380	1,920
R-squared	0.908	0.919	0.906

Notes: Standard errors clustered at the community level in parentheses
 *** p<0.01, ** p<0.05, * p<0.1

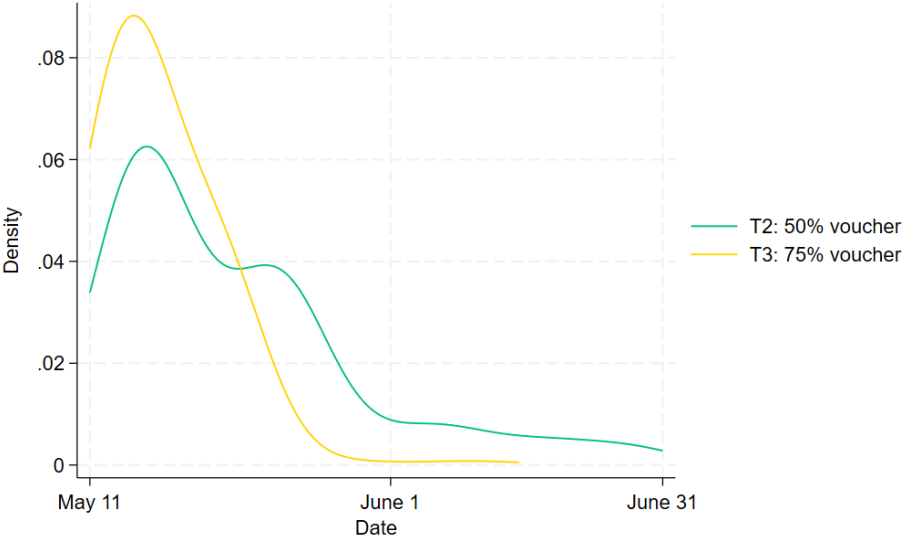
Before concluding, we turn to investigating the timing of take-up throughout the study period by treatment group. Figure 2 focuses on farmers in treatment groups 2 and 3, as these are the groups where we observe take-up, and plots the density of take-up over time. In both groups we observe an initial spike in purchases at the start of the study period followed by a gradual decline. Interestingly, the spike is higher, and the decline is steeper among farmers in treatment group 3 compared to those in treatment group 2. This suggests that the higher discount voucher provided to farmers in treatment group 3 encouraged them to purchase the bundle more quickly.

Additionally, regression results show that while there is no difference in the timing of household marketing visits between treatment groups 2 and 3 (p-value=0.619), there is a statistically significant difference in the timing of take-up on average between treatment groups 2 and 3 (p-value=0.00). Moreover, a Kolmogorov–Smirnov test for equality of distribution functions shows that these two temporal distributions are statistically different from each other (p-value=0.000).

The differential timing in take-up could be driven by a “wait and see” approach among farmers treatment group 2. While motivated to purchase the bundle, perhaps they waited a few days to observe trends in prevailing market prices (which may depend on weather conditions and government subsidies), to see if prices would fall even further, before purchasing the bundle. This mechanism aligns with qualitative reports from our household marketing visits, where initial interest in purchasing the bundle was high and seemed to largely depend on price. In treatment group 1, 91 percent of farmers said they planned to

purchase the bundle, while in treatment groups 2 and 3 nearly all farmers said they planned to purchase the bundle. Allowing for multiple responses, among farmers who didn't plan to purchase the bundle, 88 percent said this was because the bundle was too expensive, and only 19 percent said that the agro-dealer was too far away.

Figure 2: Take-up Over Time by Treatment Status



Future work, analyzing data collected with a post-harvest survey, will enable us to (i) estimate effects on additional downstream outcomes such as production and household welfare and (ii) help us understand what—if any—effects persist due to the differential timing of take-up observed among farmers receiving different levels of discount vouchers.

ABOUT THE AUTHORS

Mulubrhan Amare is a Senior Research Fellow and Temilolu Bamiwuye is a Research Analyst in IFPRI’s Development, Strategy, and Governance Unit. Rewa Misra is the Head of National Policy and Innovative Financing in the HarvestPlus section of the Innovation Policy and Scaling Unit at IFPRI. Kate Ambler is a Senior Research Fellow, Jeffrey Bloem is a Research Fellow, and Julia Wagner is a Research Analyst in the Markets, Trade, and Institutions Unit at IFPRI.

REFERENCES

Adelaja, A. and George, J. (2019) “Effects of conflict on agriculture: Evidence from the Boko Haram insurgency,” *World Development*, volume 117, pp. 184-195.

Azad, A., E. Crawford, and H. Kaila. 2018. *Conflict and Violence in Nigeria: Results from the North East, North Central, and South South Zones*. Washington, DC: World Bank Group.

Carter, M., Laajaj, R., and Yang, D. (2021) “Subsidies and the African Green Revolution: Direct Effects and Social Network Spillovers of Randomized Input Subsidies in Mozambique,” *American Economic Journal: Applied Economics*, vol. 13, no. 2, pp. 206-229.

Christiaensen, L. (2023) “Agriculture in Africa – Telling Myths from Facts: A Synthesis,” *Food Policy*, volume 67, pp. 1-11.

George, J., Adelaja, A., and Weatherspoon, D. (2020) “Armed Conflicts and Food Insecurity: Evidence from Boko Haram’s Attacks,” *American Journal of Agricultural Economics*, volume 102, pp. 114-131.

International Crisis Group (2023) “Rethinking Resettlement and Return in Nigeria’s Northeast,” Briefing 184, 16 January 2023.

McGuirk, E. and Nunn, N. (2023) "Transhumant Pastoralism, Climate Change, and Conflict in Africa," *Review of Economic Studies*, forthcoming.

Misra, R., Amare, M., Ambler, K., Bamiwuye, T., Bloem, J.R., and Wager, J. (2023) "Promoting a Bundle of Biofortified Seeds and Agricultural Inputs in Northeastern Nigeria," Project Note, CGIAR Initiative on Fragility, Conflict, and Migration.

National Population Commission - NPC and ICF (2019) *Nigeria Demographic and Health Survey 2018 – Final Report*, NPC and ICF.

UNICEF (2023) "25 million Nigerians at high risk of food insecurity in 2023," Press release, 16 January 2023.

This work was supported by the Norwegian Agency for Development Cooperation (Norad) under the project titled, 'Learning Support for a Sub-Saharan Africa Multi-Country Climate Resilience Program for Food Security,' and by the donors who fund the CGIAR Research Initiative on Fragility, Conflict, and Migration (FCM), through their contributions to the CGIAR Trust Fund: <https://www.cgiar.org/funders/>

This publication has not been peer reviewed. Any opinions stated herein are those of the author(s) and not necessarily representative of or endorsed by CGIAR or IFPRI.

INTERNATIONAL FOOD POLICY RESEARCH INSTITUTE

A world free of hunger and malnutrition

IFPRI is a CGIAR Research Center

1201 Eye Street, NW, Washington, DC 20005 USA | T. +1-202-862-5600 | F. +1-202-862-5606 | Email: ifpri@cgiar.org | www.ifpri.org | www.ifpri.info

© 2024 International Food Policy Research Institute (IFPRI). This publication is licensed for use under a Creative Commons Attribution 4.0 International License (CC BY 4.0). To view this license, visit <https://creativecommons.org/licenses/by/4.0>.