

AGRA at Ten Years: Searching for Evidence of a Green Revolution in Africa

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More than a decade after a renewed push for an African Green Revolution began in earnest, and after a decade of program implementation by the Alliance for a Green Revolution in Africa (AGRA), there is an urgent need to examine whether or not there is evidence of a green revolution underway. AGRA's stated goals are to double yields and incomes for 30 million farming households by 2020. Despite millions of dollars spent by AGRA since 2006, few comprehensive evaluations of AGRA have been made available. An additional USD 30 billion was recently pledged at the African Green Revolution Forum to continue AGRA's work and help launch the organization's new strategic vision, without a clear understanding of how effective AGRA has been in increasing agricultural productivity and adoption of green revolution technologies and reducing poverty and malnutrition in the countries over the past decade.

Lessons learned from the Green Revolution of the 1960s and 1970s, which succeeded primarily in Asia and Latin America, should serve as an important reminder of both the unintended consequences of Green Revolution technologies and processes and the large role that governments played where success was achieved. With that in mind, this assessment focuses on the extent to which there is evidence of a green revolution in agriculture in AGRA's target countries, in terms of both increased productivity of staple food crops and technology adoption. This is achieved by looking broadly across all 13 of AGRA's initial focus countries using national-level data, in conjunction with in-depth case studies of three AGRA countries using nationally representative household survey data and peer-reviewed research.

Overall, we find little evidence that AGRA is achieving the productivity and income gains necessary to meet its targets. Where there is evidence of progress, we find it primarily in countries that support technology adoption through government-sponsored agricultural input subsidy programs (FISPs), rather than countries with large AGRA investments and emphasis.

Productivity gains limited and inconsistent across crops and countries (see Table 1)

Across the thirteen countries where AGRA worked, production of maize, rice, wheat, and pulses has increased between 2006 and 2014, but growth was due as much to bringing new land into production as it was to increasing productivity.

- Across all AGRA countries, we find large production gains for maize (69%), rice (79%), wheat (82%) and pulses (75%), but only 22% for cassava, a staple crop in many AGRA countries. Overall, cereal production has increased only 33%.
- Productivity increases, however, accounted for barely half of the increased production. Yield increased by only 38% for maize, 22% for rice, 23% for wheat 46% for pulses, and 9% for cassava.

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- More traditional and drought-tolerant food crops, such as millet and sorghum, saw declining or stagnant production, with only small yield increases over the period. This indicates the shift of land and investment to other crops favored by AGRA.

Maize – Weak productivity gains (see Table 2)

- For maize, the primary staple crop in 9 of AGRA’s 13 focus countries, yields have increased only 38% during AGRA’s tenure. Of the top maize producing countries, only Ethiopia and Malawi raised production primarily through intensification.
- Nigeria and Kenya, two of the top five maize producers, saw declining yields, while the third, Tanzania, saw annual yield growth of just 1%.
- Three of AGRA’s four “breadbasket” countries, Tanzania, Mozambique, and Ghana, had annual yield growth rates below 2% despite receiving larger amounts of funding and support relative to other countries.

There is little evidence that AGRA can meet its goal of doubling farming households yields by 2020. As of 2014, more than halfway to AGRA’s 2020 benchmark, no major staple crop had shown even a 50% increase in productivity. While yields during the AGRA period were generally higher than the previous 7-year average, and seem to have reversed a period of stagnation or decline, yield growth overall is well behind the pace needed to achieve AGRA’s goal of doubling productivity by 2020.

Input subsidy programs largely responsible for gains in productivity and input use

Nearly all AGRA countries have some form of input subsidy program that promotes the adoption of favored crops, notably maize (among others). These programs have been only mildly successful in promoting GR technologies and yields, but these data suggest that FISPs, as expected, may be largely responsible for what green revolution advances we have seen in AGRA countries. We find:

- Countries without input subsidy programs saw declining productivity for rice (-3%), cassava (-21%), millet (-9%), sorghum (-26%), and oilcrops (-1%). No productivity declines were seen in countries with agricultural inputs subsidy programs (FISPs).
- Where productivity gains were seen in both FISP and non-FISP countries, gains were larger and more predictable in FISP countries for the majority of crops. FISP productivity increased by 5 to 30 percentage points more than non-FISP countries for rice, wheat, and total cereals.
- Average fertilizer use is significantly higher in FISP countries at 23.6 kilograms per hectare compared to only 4.4 in non-FISP countries.
- While fertilizer use has increased by 39% on average across AGRA countries, average application rates of 20 kilograms per hectare remain far below the Abuja Declaration target of 50 kg/ha.
- Lack of strong data on improved seed use over time make conclusions about AGRA’s impact on improved variety adoption impossible to assess.

A recent article in the journal *Food Policy* surveyed the evidence from seven countries with input subsidy programs and found little evidence of sustained – or sustainable – success. “The empirical record is increasingly clear that improved seed and fertilizer are

not sufficient to achieve profitable, productive, and sustainable farming systems in most parts of Africa,” wrote the authors in the conclusion.²

Production gains insufficient to eradicate rural poverty, hunger, and malnutrition

- While hunger and malnutrition are on the decline across AGRA countries, Global Hunger Index scores remain in the “serious” to “alarming” category for 12 of the 13 AGRA countries.
- In five AGRA countries, half of the rural population lives below the national poverty line. Poverty affects between 22 and 78% of the rural populations in AGRA countries.
- Evidence from Malawi, Zambia and Mozambique indicates disparities in rural and urban poverty and malnutrition indicators, as well as alarmingly high rates of acute and chronic malnutrition in young children in rural areas.

Examining the experience of smallholders in Malawi, Zambia, and Mozambique

Case studies of Malawi and Zambia call into question the narratives around two so-called Green Revolution “success stories,” and the viability of increased technology adoption to spur productivity gains. These case studies, each with extensive input subsidy programs, also reveal cause for concern regarding the sustainability of AGRA’s model. A closer look at Mozambique, a priority AGRA country without a significant input subsidy program, suggests how limited AGRA’s impact has been without subsidy support.

Malawi - Though Malawi registered impressive gains in maize production in the first years of its input-subsidy program, and those gains were due largely to increased use of green revolution technologies, in more recent years yield growth has stagnated, confirming fears of a yield plateau from the use of inorganic fertilizers on monocropped maize farms. Further, the input subsidy regimen is proving fiscally unsustainable, with budget cuts reducing the reach and impact of the program. Without input subsidies, there is evidence that the high costs of inputs to farmers make green revolution technology adoption unprofitable for smallholders. Evidence from Malawi shows that maize yield gains achieved through hybrid maize seed and synthetic fertilizer use are unlikely to offset additional input costs for smallholders, and in fact may result in income deficits for farmers (ACBio 2014, 55).

Zambia - Maize production more than doubled during the years of AGRA implementation, a process primarily driven by extensification as maize area expanded 77% relative to yield increases of only 40%. Wheat and rice area more than doubled as well, while area for drought-tolerant crops like cassava, millet and sorghum have declined or stagnated. Continued cropland expansion in Zambia is severely limited by the amount of potentially available cropland that can be profitably managed (Chamberlin, Jayne, and Headey 2014), and while costly government interventions in maize markets, including the FISP, have continued, little progress has been made on poverty and malnutrition. The percentage of smallholders living on \$1.25 per capita per day in rural Zambia increased from 76 to 78

² Thomas S. Jayne et al., “Review: Taking Stock of Africa’s Second-Generation Agricultural Input Subsidy Programs,” *Food Policy* 75 (February 1, 2018): 1–14, <https://doi.org/10.1016/j.foodpol.2018.01.003>.

percent between 2012 and 2015. Zambia is the only AGRA country with hunger classified as “alarming” according to the 2016 Global Hunger Index; only 54% of rural households surveyed in 2015 reported having adequate food and 33% had low dietary diversity (IAPRI 2016). In Zambia, consistently high rates of fertilizer and improved seed use are accompanied by stubbornly high rates of poverty and malnutrition.

Mozambique - Despite its designation as a “breadbasket country,” maize yield growth rates were less than one percent during AGRA implementation, with maize yield down to a shockingly low 0.8 tons per hectare by 2014. Rice yields also declined dramatically and cassava yields stagnated, even as area in rice production and fertilizer use both increased more than four-fold. While poverty has decreased according to national statistics, the prevalence of wasting and stunting in children under 5 rose between 2008 and 2011. Mozambique provides a sharp contrast to the productivity gains seen in Malawi and Zambia, demonstrating the failure of massive AGRA support to realize productivity gains in the absence of input subsidies.

Conclusions

Looking across all of AGRA’s primary countries in its first decade of program implementation, along with a closer look at Malawi, Zambia and Mozambique, AGRA is failing to promote a broad-based green revolution in Africa thus far. Where evidence of a green revolution exists, productivity gains and fertilizer use are highly correlated with agricultural input subsidies. This suggests that financing is key to promoting widespread technology adoption, which is on the docket to take on a larger role in AGRA’s future programming. But there is little evidence that in the absence of subsidized inputs small-scale farmers can earn enough from crop sales to sustain the green revolution technology package.

More worrisome still, the green revolution formula of hybrid seeds and inorganic fertilizer may be showing declining productivity as maize monocultures deplete soils whose fertility is not rebuilt with such narrow practices. Productivity gains are also highly correlated with extensification, and in many cases with an increasingly narrow array of staple crops. Meanwhile, the perverse incentives toward reduced crop diversity and extensification of supported crops are doing little to reduce high rates of poverty and malnutrition in AGRA countries, raising serious doubts about whether the push for a Green Revolution in Africa learned anything from the Green Revolutions of the past.

Moving forward, this overview study suggests the need for more thorough evidence-based monitoring and evaluation of AGRA programming and impacts, not just on production but on productivity, crop diversity, land use, and most importantly, hunger and poverty, particularly among smallholders.

Table 1. Production changes, selected crops, AGRA countries, 2004-6 to 2012-14.

% change in	Production	Yield	Area	Production	Yield	Area
		Maize			Cassava	
FISP ^c	69	37	41	32	21	54
Non-FISP ^b	72	45	14	-31	-21	18
AGRA Countries ^a	69	38	37	22	9	47
	Rice, paddy			Roots and tubers (total)		
FISP	81	29	30	27	18	46
Non-FISP	41	-3	116	-16	13	2
AGRA Countries	79	22	35	22	17	40
	Wheat					
FISP	82	24	27			
Non-FISP	47	17	68			
AGRA Countries	82	23	27			
	Millet			Pulses (total)		
FISP	-49	11	-35	69	40	16
Non-FISP	11	-9	16	103	77	32
AGRA Countries	-35	6	-13	75	46	21
	Sorghum					
FISP	-2	18	1			
Non-FISP	30	-26	-17			
AGRA Countries	1	10	0			
	Cereals (total)			Oilcrops (total)^d		
FISP	32	35	8 ^e	34	24	31
Non-FISP	36	19	22	28	-1	28
AGRA Countries	33	32	11	33	19	31

SOURCE– Authors calculations using data from FAOSTAT, downloaded February 2017.

NOTES– All numbers in this table represent a % change between the pre-AGRA baseline period (2004-2006) and the years with the most recent available data (2012-2014). Three-year averages were used to smooth year-to-year fluctuations, comparing pre-AGRA (2006) with most recent available data.

^a AGRA countries included in this analysis are 13 of the 18 countries AGRA works in, excluding countries initially deemed "post-conflict."

^b Countries included in the FISP category are Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Nigeria, Rwanda, Tanzania, and Zambia.

^c Countries included in the "non-FISP" category are Mozambique, Niger, and Uganda.

^d No information was available for soy in Mozambique, Niger, or Ghana, meaning that this comparison of FISP v. non-FISP countries for soy is simply comparing Ugandan soybean yields to average soybean yields in 9 FISP countries.

^e This average includes Nigeria, a large country whose area in production skews the results. With Nigeria excluded, this figure would be 23% for FISP countries.

Table 2. Average maize production, yield and area

pre- and post-AGRA growth rates for AGRA countries, ordered by production quantity

	Production	Yield	Production	Area	Yield	Yield
	(000 tonnes)	(MT/ha)	Annual growth rate (%) ^a			Pre-AGRA AYG (%) ^a
	Average 2012-14		2004-06 to 2012-14			1997-99 to 2004-06
Nigeria	9,303	1.6	5.2	5.9	-0.7	2.5
Ethiopia	6,628	3.2	7.9	1.9	5.7	2.7
Tanzania	5,733	1.4	5.5	4.3	1.1	-3.3
Kenya	3,619	1.7	2.7	3.1	-0.5	1.7
Malawi	3,345	2.0	7.9	0.5	7.7	-3.1
Zambia	2,912	2.7	12.1	7.4	4.3	4.2
<i>*Uganda</i>	2,748	2.5	11.0	4.3	6.4	0.3
Ghana	1,825	1.8	5.7	3.9	1.7	0.5
Mali	1,653	2.5	13.5	6.9	6.4	-0.7
Burkina Faso	1,525	1.8	9.9	8.9	1.1	1.3
<i>*Mozambique</i>	1,247	0.8	1.1	0.1	0.7	-3.8
Rwanda	608	2.4	26.3	11.0	13.8	-0.8
<i>*Niger</i>	28	1.3	16.7	11.5	4.7	1.8
FISP	37,151 ^b	2.1 ^c	6.7	4.4	2.8	1.3
<i>*Non-FISP</i>	4,023	1.5	7.0	1.7	7.3	-2.2
All AGRA	41,174	1.9	6.8	4.0	3.2	1.0

SOURCE– Authors calculations using data from FAOSTAT, downloaded February 2017.**NOTES**– *Italics indicate non-FISP countries.* Countries ordered by production to distinguish top maize producing countries based on the most recent available data.^a FISP, non-FISP and All AGRA yield growth rates are based on 3-year average weighted annual yields (weighted by country's share of maize production in that year). Other growth rates use simple 3-year averages.^b Aggregated average production for 2012-14 represents the sum of total production for the category.^c Aggregated average 2012-14 yields for FISP, non-FISP, and all AGRA countries are formatted as simple yield averages.