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**Failing Africa's Farmers:
An Impact Assessment of the
Alliance for a Green Revolution in Africa**

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Abstract

The Alliance for a Green Revolution in Africa (AGRA) was founded in 2006 with the goal of bringing high-yield agricultural practices to 30 million smallholder farming households. With the adoption of commercial seeds and inorganic fertilizer, AGRA set out to double crop productivity and incomes while halving food insecurity by 2020. As AGRA reaches its self-declared deadline for these ambitious goals, how well has AGRA done in increasing productivity, incomes, and food security? The organization has received roughly \$1 billion in funding, two-thirds of it from the Bill and Melinda Gates Foundation, and disbursed more than \$500 million in grants, mainly in 13 priority African countries. The Green Revolution technology campaign has been supported during this time by international programs far larger than AGRA and notably by national governments in Africa, which have spent roughly \$1 billion per year on programs that subsidize the purchase of commercial seeds and fertilizers. There is little publicly available documentation of impacts, from AGRA, the Gates Foundation, or donor governments that have supported the initiative. This paper attempts to fill some of that accountability gap. Because AGRA declined to provide data from its own monitoring and evaluation, we use national-level data to assess progress in productivity, poverty reduction, and food security in AGRA’s 13 countries. We find little evidence of widespread progress on any of AGRA’s goals, which is striking given the high levels of government subsidies for technology adoption. There is no evidence AGRA is reaching a significant number of smallholder farmers. Productivity has increased just 29% over 12 years for maize, the most subsidized and supported crop. This falls well short of doubling yields, which would be a 100% increase. Overall staple crop yields have grown only 18% over 12 years. Meanwhile, undernourishment (as measured by the FAO) has increased 30% in AGRA countries. These poor indicators of performance suggest that AGRA and its funders should change course. We review more promising approaches African governments and donors should consider.

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Introduction

The Alliance for a Green Revolution in Africa (AGRA) was initiated in 2006 by the Bill and Melinda Gates Foundation, leveraging a major donation from financier Warren Buffet to add an international development program to the foundation's established work in education and public health. The Rockefeller Foundation, the lead funder of the first Green Revolution, signed on as well. As the name indicated, the goal was to bring the kind of high-yield, input-intensive agriculture to Africa that had failed to take hold on the continent when the first Green Revolution swept through much of Asia and Latin America in the 1960s and 1970s. Now, argued AGRA's founders, science had developed the seed and other technologies to give Africa its own Green Revolution, one tailored to the specific ecological and climatic conditions across the continent. While the technologies may have evolved, the basic approach was the same: promoting the adoption of new high-yield seed varieties fed with inorganic fertilizer.

From its founding AGRA set ambitious goals. Leaders set out to double incomes for 20 million smallholder households in Africa while halving food insecurity in 20 countries by 2020.² By 2015, those goals had grown more specific and more ambitious, with AGRA vowing to double crop yields and incomes for 30 million farming households by 2020.³ With the Gates Foundation and donor governments providing nearly \$1 billion in contributions and disbursing \$524 million in grants, AGRA initially focused its work in 18 countries, soon reduced to 13.⁴ AGRA worked with governments to speed the development of high-yield commercial seeds designed for Africa's wide range of soils and climates and to facilitate the delivery to farmers of those seeds and the inorganic fertilizers that would make them grow. Through grants to governments and intermediary organizations, AGRA set out to bring commercial inputs to millions of small-scale farmers.

AGRA was always controversial with Africa's farmer organizations. Many warned that it was seeking to impose Western technologies inappropriate for the continent's soils, farmers, and food systems. Some decried the lack of consultation with African farmers on the nature of the interventions.⁵ Others pointed out the serious flaws in the first Green Revolution: water supplies depleted and contaminated with chemical runoff; farmers indebted due to high input costs while yields declined after their initial increases; and the loss of crop and diet diversity as Green

² AGRA, "AGRA Annual Report 2008," 2009, <https://agra.org/AGRAOld/wp-content/uploads/2016/04/agra-annual-report-2008.pdf>.

³ AGRA web site, "What We Do: Grants," <https://web.archive.org/web/20190406032154/https://agra.org/grants/>, accessed May 18, 2020. AGRA is inconsistent in how it describes its goals, usually weakening them by saying it will "contribute to" doubling yields and incomes, or reducing them to just "increasing" yields and incomes. Some documents extend their timeline to 2021, though many still refer to the original 2020 deadline. As of June 11, 2020, AGRA had taken the explicit goals statement off its grants web page.

⁴ AGRA, "AGRA Annual Progress Report, 2007-2016" (AGRA, March 2017), <https://agra.org/AGRAOld/wp-content/uploads/2017/06/2016-AGRA-Progress-Report-Final.pdf>; AGRA, "AGRA 2017 Annual Report" (Nairobi, Kenya: AGRA, 2018), <https://agra.org/wp-content/uploads/2018/08/AGRA-2017-Annual-Report0708201802.pdf>; Calculated from AGRA reports: AGRA, "AGRA 2018 Annual Report" (Nairobi, Kenya: AGRA, 2019), https://agra.org/ar-2018/wp-content/uploads/2019/07/AGRA-Annual-Report_v18_FINAL_Print-Ready_LR.pdf.

⁵ InterPares, "Coalition Pour La Protection Du Patrimoine Génétique Africain (COPAGEN)," Inter Pares, accessed March 23, 2020, <https://interpares.ca/content/coalition-pour-la-protection-du-patrimoine-g%C3%A9n%C3%A9tique-africain-copagen>.

Revolution crops took over the countryside. African farm groups also warned of the loss of food sovereignty, the ability of communities and nations to freely choose how they wanted to feed themselves, as large commercial firms could come to dominate local markets backed by new government policies designed to ensure market access.

Since AGRA's founding, scientists and world leaders have gained growing awareness of the limitations of input-intensive agricultural systems, particularly to mitigate and adapt to climate change. A 2009 interagency report by a large number of scientists showed that industrial agriculture was ill-suited to the climate, soils, and needs in developing countries, arguing forcefully that "business as usual is no longer an option."⁶ The U.N. Intergovernmental Panel on Climate Change in 2019 documented the contributions of industrialized agriculture to climate change, calling for profound changes to both mitigate and help farmers adapt to climate disruptions.⁷ An expert panel from the U.N. Food and Agriculture Organization (FAO) published a detailed analysis in 2019 of the contributions ecological agriculture could make to food security and long-term sustainability.⁸ As former FAO Director General Jose Graziano da Silva had earlier indicated, "We need to promote a transformative change in the way that we produce and consume food. We need to put forward sustainable food systems that offer healthy and nutritious food, and also preserve the environment. Agroecology can offer several contributions to this process."⁹

AGRA has now been in operation for 14 years, reaching its self-declared deadline of 2020.¹⁰ How well have its promises fared in more than a decade of Green Revolution programming and promotion? AGRA has received nearly \$1 billion in contributions and granted roughly \$524 million during that time, mostly in 13 target countries. What is the return on that investment? Are there signs that a Green Revolution has come to these African countries? Are Green Revolution interventions reaching a significant share of smallholder farmers? Are they benefiting from rising productivity, increasing incomes, and reduced hunger? Is AGRA's continued focus on disseminating high-input agriculture to African smallholders consistent with the best science and policy recommendations on climate change?

Unfortunately, AGRA has published no overall evaluation of the impacts of its programs on the number of smallholder households reached nor the improvements in their yields and household incomes. Periodic reports simply highlight intermediate objectives – number of new seed varieties released, tons of seed produced in-country by domestic seed companies, number of

⁶ IAASTD, "Major Agricultural Report: 'Business as Usual Is Not an Option,'" 2009,

<https://www.globalagriculture.org/fileadmin/files/weltagrarbericht/IAASTDBerichte/IssuesBriefTrade.pdf>.

⁷ IPCC, "Special Report on Climate Change and Land: An IPCC Special Report on Climate Change, Desertification, Land Degradation, Sustainable Land Management, Food Security, and Greenhouse Gas Fluxes in Terrestrial Ecosystems" (Intergovernmental Panel on Climate Change, 2019), <https://www.ipcc.ch/srccl/>.

⁸ HLPE, "Agroecological and Other Innovative Approaches for Sustainable Agriculture and Food Systems That Enhance Food Security and Nutrition" (Rome, Italy: High Level Panel of Experts, FAO, 2019), <http://www.fao.org/3/ca5602en/ca5602en.pdf>.

⁹ FAO, "Agroecology Can Help Change the World's Food Production for the Better," April 3, 2018, <http://www.fao.org/news/story/en/item/1113475/icode/>.

¹⁰ More recent AGRA documents shift the deadline to 2021. Some AGRA documentation reduces its goal from doubling productivity and incomes to "increasing" productivity and incomes.

farmers trained in new agronomic practices, number of crop breeders trained.¹¹ Neither the Gates Foundation nor any of the international donors that have supported AGRA over the years have published evaluations of the return on their large investments.¹² This lack of accountability represents a serious oversight for a program that has consumed so much in the way of resources and driven the region's agricultural development policies with its narrative of technology-driven agricultural development.¹³

The purpose of this report is to fill that accountability gap using the best data and information to which we have access. AGRA declined our request to provide data from their own internal monitoring and evaluation of progress. In the absence of data on AGRA's direct beneficiaries, we rely on national-level data from 13 AGRA countries on production, yield, and area harvested for most of the region's important food crops to assess the extent to which a Green Revolution in productivity is occurring. We also examine the available data on poverty, hunger, and malnutrition to gauge whether there are signs that smallholder farmer incomes and food security are improving dramatically across the region.

Background

The Gates Foundation's timing in founding AGRA in 2006 was fortuitous. No sooner had AGRA been launched than food prices spiked on international markets, prompting food riots in more than 20 countries. Rice prices tripled. With some exporting countries restricting exports to protect domestic food security, some importing countries found they could not buy rice on international markets at any price. Maize prices more than doubled, largely in response to the sudden and rapid government-mandated diversion of the U.S. crop to ethanol production. In a few short years following the 2005 and 2007 Renewable Fuel Standard legislation, some 40% of U.S. maize was going into cars instead of feed and food markets. With the United States the faraway leader in global corn production, that represented a diversion of fully 15% of global supply. Combined with China's rising imports of soybeans for domestic pork production to feed its growing middle class, the shocks sent prices soaring.

¹¹ AGRA, "AGRA Annual Progress Report, 2007-2016."

¹² There are unconfirmed reports that the Gates Foundation conducted or commissioned an internal evaluation of AGRA in 2016. If so, the foundation has not released any information to the public.

¹³ We could find only partial evaluations of individual programs or interventions, such as: DFID, "Alliance for a Green Revolution in Africa (AGRA) [GB-1-113691]," DFID Development Tracker, May 4, 2012, <https://devtracker.dfid.gov.uk/projects/GB-1-113691/documents>; DFID; "PASS-Book-Web.Pdf," accessed March 6, 2020, <https://agra.org/wp-content/uploads/2018/02/PASS-Book-web.pdf>; "Going-Beyond-Demos-Final-SHP-Book-26th-Sept-2016.Pdf," accessed March 9, 2020, <https://agra.org/wp-content/uploads/2018/04/Going-Beyond-Demos-Final-SHP-book-26th-Sept-2016.pdf>; Dalberg Global Development Advisors, "Evaluation of the Market Access Program: Final Report" (Dalberg Global Development Advisors, September 2015); Raissa Fabregas et al., "Evaluating Agricultural Information Dissemination in Western Kenya" (International Initiative for Impact Evaluation, December 2017); International Initiative for Impact Evaluation, "International Initiative for Impact Evaluation (3ie) -- Financial Inclusion of Smallholder Farmers in Ghana and Kenya," YPARD | Young Professionals for Agricultural Development, June 21, 2016, <https://ypard.net/opportunity/international-initiative-impact-evaluation-3ie-financial-inclusion-smallholder-farmers-g>; Kwaw Andam, Simrin Makhija, and David Spielman, "Evaluation Of The Impacts Of A Soil Fertility Training Project On Farm Productivity In The Volta Region Of Ghana," 2019, <https://developmentevidence.3ieimpact.org/search-result-details/impact-evaluation-repository/evaluation-of-the-impacts-of-a-soil-fertility-training-project-on-farm-productivity-in-the-volta-region-of-ghana/7709>.

Food-importing countries were among the hardest hit, and African countries had gone from being a net food exporter before the mid-1970s to becoming a large net food importer.¹⁴ They had followed economic advice from the World Bank and other international donors to import food, which was inexpensive and in surplus from developed countries, and focus their economic activities on crops or activities for which they had a “comparative advantage” rather than depending on low-productivity small-scale farming. With food prices spiking, that trade-off suddenly looked like a dangerous gamble. Many developing country governments vowed to increase their food self-sufficiency, and they saw that the only way to do so was to invest in the farmers who were still growing most of their countries’ food: small-scale producers. Donors and international agencies soon followed suit, acknowledging that developing countries should grow more of their own food and should invest in the smallholder farming sector to do it.¹⁵

African governments were already moving in that direction before the price spikes hit. African governments in 2006 launched the Comprehensive African Agricultural Development Program (CAADP), in which signatories agreed to raise government commitments to agricultural development to at least 10% of spending. The Abuja Declaration that same year set a target for raising inorganic fertilizer use to at least 50 kg/ha in all countries, a dramatic increase over prevailing levels.¹⁶

With the new food crisis, the urgency of growing more of one’s own food grew. AGRA offered the ready-made answer to African governments’ question: How can we increase domestic food production? AGRA’s answer: high-yield seeds, inorganic fertilizers, and market-oriented reforms to allow the firms that sold such products to operate freely throughout the region. Many governments had allowed their agriculture ministries and extension services to wither under austerity programs in previous decades. Here were AGRA and a host of allied international donors offering financial support and advisers to bring Africa its own Green Revolution.

¹⁴ Manitra A. Rakotoarisoa, Massimo Iafrate, and Marianna Paschali, “Why Has Africa Become a Net Food Importer? Explaining Africa Agricultural and Food Trade Deficits” (Rome: Trade and Markets Division, Food and Agriculture Organization of the United Nations, 2011), 1.

¹⁵ High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, “Investing in Smallholder Agriculture for Food Security,” HLPE Report 6 (Rome, Italy: Committee on World Food Security, June 2013), http://www.fao.org/fileadmin/user_upload/hlpe/hlpe_documents/HLPE_Reports/HLPE-Report-6_Investing_in_smallholder_agriculture.pdf.

¹⁶ AfDB, “Abuja Declaration on Fertilizer for the African Green Revolution,” African Development Bank, accessed May 17, 2017, <https://www.afdb.org/en/topics-and-sectors/initiatives-partnerships/african-fertilizer-financing-mechanism/abuja-declaration/>.

The Alliance for a Green Revolution in Africa (AGRA)

AGRA is chartered as “an international non-profit, Non-Governmental Organization committed to ending hunger and promoting economic growth in Africa by improving the productivity and profitability of small-scale farmers.” Since its founding in 2006, AGRA has received nearly \$1 billion in contributions and disbursed \$524 million in grants in 18 countries through an evolving set of programs intended to promote the widespread adoption of commercial seeds and inorganic fertilizers.¹⁷ Since 2015, AGRA’s goal has to double agricultural productivity and incomes for 30 million smallholder farm households, 9 million directly and 21 million indirectly, though their public commitment to such goals has recently been less visible.¹⁸ AGRA also supports the development of policies and market structures that facilitate the adoption of such Green Revolution technology packages.

AGRA’s programs and priority countries have shifted over its 14-year history. (See Appendix 1 for a more detailed description.) For its first nine years it provided grants to governments, nongovernmental organizations, and private sector partners under three main programs:

- Program for Africa’s Seed Systems (PASS) to promote the development and use of high-yield commercial seeds;
- Soil Health Program (SHP) to promote the increased use of inorganic fertilizer and other soil practices in the name of Integrated Soil Fertility Management (ISFM); and
- Market Access Program (MAP) to promote farmer access to input and output markets.

In 2016 AGRA shifted to its integrated Partnership for Inclusive Agricultural Transformation in Africa (PIATA) initiative, with work organized in programs for Policy and Advocacy, Agricultural Enterprises, Inputs, Markets, Process and Storage, and Finance.

AGRA’s largest donor by far has been the Gates Foundation, which through 2018 had provided \$661 million in support.¹⁹ Other funding has come from the Rockefeller Foundation and a few other foundations, some private companies, and donor governments including USAID, UKAID, and German Cooperation. The Green Revolution effort received a new burst of funding support in 2016. AGRA was central to convening the African Green Revolution Forum (AGRF), which took the lead from the Gates Foundation to recommit donors to Green Revolution promotion. The “Seize the Moment” fund drive netted a range of commitments from international agencies, private foundations, donor governments, and private companies totaling \$30 billion.²⁰ Only a small fraction of that support is for AGRA, though it is difficult to trace those commitments. The largest commitment came from the African Development Bank (AfDB), which pledged \$24

¹⁷ Estimates are through 2018 based on AGRA Annual Reports.

¹⁸ AGRA web site, “What We Do: Grants,”

<https://web.archive.org/web/20190406032154/https://agra.org/grants/>, accessed May 18, 2020. AGRA is inconsistent in how it describes its goals, usually weakening them by saying it will “contribute to” doubling yields and incomes, or reducing them to just “increasing” yields and incomes. Some documents extend their timeline to 2021, though many still refer to the original 2020 deadline. As of June 11, 2020, AGRA had taken the explicit goals statement off its grants web page.

¹⁹ From Bill and Melinda Gates Foundation grants database through 2017, tax filing for 2018.

²⁰ AGRA, “More than US \$30 Billion Promised in Unprecedented Commitment to African Agriculture,” *Impact Magazine*, November 4, 2016, <https://agra.org/news/more-than-us-30-billion-in-commitment-to-african-agriculture/>

billion over ten years to help finance the delivery of “modern agricultural technologies” to smallholder farmers.

Akinwumi Adesina, former head of AGRA and now AfDB president, was clear that the intent of the new commitments was partly to speed the changes in national-level policies: “We should not waste time in reversing policies whenever there is change in governments.”²¹ Indeed, reforming national and regional seed policies has always been a high priority for AGRA.

There is little indication that AGRA has increased its grantmaking since the “Seize the Moment” commitments. In fact, grants in 2017 and 2018 were down considerably compared to previous years, according to AGRA’s annual reports. Income from contributions was up, however, to nearly \$95 million in 2018 from just \$47 million in 2016. It is worrisome that AGRA that year spent almost as much on program management and administration (\$44.5 million) as it did on grants (\$48.4 million). The same high level of overhead was reported for 2017.²² The remainder of AGRA’s budget in recent years has gone to program administration, including for the Africa Enterprise Challenge Fund which supports African agribusiness initiatives, and to salaries, which in 2018 represented more than \$22 million, including \$310,000 for AGRA director Agnes Kalibata.²³

AGRA now works in 11 countries but for most of its history it worked in 13, which are covered in this report: Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Tanzania, Uganda, and Zambia. (Niger and Zambia were eliminated but Zambia is now in the process of rejoining AGRA.) Support has varied greatly by country, with Tanzania getting the most support through 2018 (\$77.1m), followed by Ghana (\$74.4m).²⁴

Assessing AGRA’s Impacts

AGRA’s ambitious goals were based on a strong set of premises:

- AGRA and related Green Revolution promotion efforts could reach 30 million smallholder households;
- High-yield seeds and synthetic fertilizers would be adopted by the majority of smallholders in Africa if the inputs could be made available to them;
- Those inputs, and related investments in marketing and financing, would double yields on priority food crops;

²¹ Isaiah Espisu, “Farm boost of \$30 billion aimed at helping Africa ‘feed itself’”, Reuters, September 8, 2016.

<https://af.reuters.com/article/idUSKCN11E2C1>

²² In 2018, AGRA listed as expenses the following expenses: Direct Program (\$10.9m), Africa Enterprise Challenge Fund Management (\$8.9m), Program Support (\$15.7m), and Administration and Support (\$9.0m) for a total of \$44.5m, compared to \$48.4m in grants. https://agra.org/ar-2018/wp-content/uploads/2019/07/AGRA-Annual-Report_v18_FINAL_Print-Ready_LR.pdf

²³ ProPublica, “ALLIANCE FOR A GREEN REVOLUTION IN AFRICA - Form 990 for Period Ending Dec 2018 - Nonprofit Explorer,” ProPublica, accessed April 6, 2020, https://projects.propublica.org/nonprofits/display_990/980513530/12_2019_prefixes_94-99%2F980513530_201812_990_2019121716962428.

²⁴ A full list of grant amounts by country is included in the appendix.

- Increased production would give smallholder families a surplus they could sell on the market;
- Those sales would allow them to double their incomes, resulting in a dramatic reduction in rural poverty and food insecurity;
- Those improvements could be sustained over time.

There are good reasons to question each of these premises. Some of those reasons draw on the lessons from the first Green Revolution, which is credited with saving millions of lives in India and other countries through the dissemination of such high-yield inputs. Many now recognize that the social and environmental costs were high. Historians more recently have revisited the claims made on behalf of the first Green Revolution, calling into question just how much of a productivity boost it offered and whether high-yield seeds and fertilizers were the most important contributors to what success it can claim.

Africa's Green Revolution in Context: Revisiting the First Green Revolution

It is worthwhile to revisit the model on which AGRA is based, the widely hailed effort to improve food production in Asia and Latin America through the active promotion of new high-yield seed varieties supported by applications of inorganic fertilizer. U.S. crop breeder Norman Borlaug won a Nobel Prize for his development of a high-yield variety of wheat and his galvanizing effort to promote the adoption of improved varieties of wheat, rice, and maize – the world's three main staple grains – in India and other developing countries suffering widespread hunger and periodic famines. The effort, which transformed agriculture in much of India, was credited with saving millions of lives by allowing Indian farmers to grow much more food.

This first Green Revolution, which had significant impacts in much of Asia and Latin America but not in Africa, has always had its critics. From the beginning, many warned that the technology package would prove unsustainable, leading to long-term declines in soil fertility, depletion and contamination of groundwater supplies, and impoverishment of many small-scale farmers who would not be able to sustain crop yields or profits from their sale as they took on the higher costs of such input-intensive farming practices.²⁵

In hindsight, many of those warnings have proven accurate.

Recently, historians have examined the myths and realities of the first Green Revolution.²⁶ Their accounts, grounded in empirical data, much of it from India, suggest that crop yields for wheat and rice did not increase significantly faster after Green Revolution innovations than they were already rising. Agriculture was not stagnant and the new technologies did not appreciably increase yield growth. In that context, the claim of “millions of lives saved” has to be revised;

²⁵ See, for example: Vandana Shiva, *The Violence of the Green Revolution: Third World Agriculture, Ecology, and Politics* (University Press of Kentucky, 2016).

²⁶ For a good overview, see: Glenn Davis Stone, “Commentary: New Histories of the Indian Green Revolution,” *The Geographical Journal* 185, no. 2 (June 2019): 243–50, <https://doi.org/10.1111/geoj.12297>; Kapil Subramanian, “Revisiting the Green Revolution: Irrigation and Food Production in Twentieth-Century India” (Ph.D., England, University of London, King's College (United Kingdom), 2015), <https://search-proquest-com.ezproxy.library.tufts.edu/docview/1837038837?pq-origsite=primo>.

some historians suggest that even in the short term the new technology package may have had only a negligible impact on hunger in India. There is also evidence that high-yield seed genetics was not the most important input responsible for the yield increases Indian farmers observed, nor was inorganic fertilizer. The most important input was irrigation, according to recent studies, as the Indian government and donors supported the widespread installation of tube wells. In any case, the long-term environmental toll on India's farmers and landscapes has been severe. Even long-time advocates of the Green Revolution approach acknowledge the damage caused by the technologies and practices it promoted.²⁷

African governments do not want to repeat the errors of first Green Revolution – GR1.0 – as they seek to develop their own farming practices. It is not clear that such lessons are being heeded in the rush to raise productivity in Africa. Perhaps more important, while GR2.0 promises Africa its own Green Revolution with new seed varieties tailored to specific conditions across the continent, the technology package being promoted leaves out many of the features that promoted productivity increases in Asia. Irrigation is the most obvious omission: There is little investment by AGRA or other agencies in widespread development of localized irrigation for smallholder farmers. GR2.0 also neglects to offer strong government programs for extension, credit, infrastructure, marketing, and other crucial elements.

It may not be surprising that an initiative launched by a technology magnate like Bill Gates would prove to be enamored of exciting new features while failing to appreciate the popularity – and importance – of some of the old features. The history of GR1.0 suggests that GR2.0 may be an upgrade with similar design flaws.

AGRA: A small part of a larger Green Revolution campaign

To the extent that we find progress in raising productivity it would be a mistake to attribute that process primarily to AGRA. In fact, AGRA is one of many initiatives coming from the donor community, national governments, and regional institutions to promote Green Revolution policies across the continent. The 2014 Malabo Declaration sets ambitious goals for all African countries, many of them focused on raising productivity by increasing the use of commercial seeds and synthetic fertilizers.²⁸ Those include, for example, the goal of doubling agricultural productivity. They also include measures related to reducing hunger and poverty, similar to AGRA's goal of doubling incomes for smallholder households. These goals are backed by a wide range of donor programs to change seed and land policies, improve marketing infrastructure and storage facilities, supply new crop varieties developed in the international CGIAR system, and train crop breeders and other researchers. AGRA is just one of many well-funded initiatives working to promote increased input use in Africa. In the absence of any detailed impact evaluation of AGRA's work, it is virtually impossible to distinguish AGRA's particular contributions from those of these allied efforts. As such, it is easy to overestimate the program's actual success in promoting Green Revolution practices.

²⁷ See, for example, the chapter on India's Punjab in Joel K Bourne, *The End of Plenty: The Race to Feed a Crowded World* (W. W. Norton & Company: W. W. Norton & Company, 2015).

²⁸ "Malabo Declaration on Accelerated Agricultural Growth | AUDA-NEPAD," accessed March 19, 2020, <https://www.nepad.org/caadp/publication/malabo-declaration-accelerated-agricultural-growth>.

This is particularly true in light of the widespread use of Farm Input Subsidy Programs (FISPs), which in varying forms heavily subsidize or support the dissemination and adoption of high-yield commercial seeds and synthetic fertilizers among smallholder farmers. Of AGRA's 13 focus countries, only three – Mozambique, Niger, and Uganda – do not have significant FISP programs. The resources expended by national governments on such programs, often heavily supported with donor funds, generally dwarf those invested by AGRA. Where AGRA grants \$40-\$50 million per year in its supported countries, aggregate government expenditures on FISPs approach \$1 billion per year,²⁹ more than twenty times AGRA's funding. Because the subsidies directly incentivize the adoption of the Green Revolution technology package among large numbers of farmers, they represent a larger and more direct intervention than any of AGRA's initiatives, which often complement FISP efforts.

Because of the prevalence of FISPs across most AGRA countries, and because many of those programs have been evaluated more extensively than have AGRA's interventions, increases in technology adoption and resulting increases in productivity can often be more directly attributed to FISPs.

Even though most FISP initiatives directly support AGRA's overall objectives, AGRA has always maintained some distance from such policies. In many AGRA documents, the organization is critical of broad-based subsidies as wasteful, failing to target assistance to the sorts of better-endowed commercial farmers who can make productive use of the technology package. AGRA has supported policy evaluations to promote more "market-oriented" interventions less dependent on government "handouts." AGRA has advocated stronger participation by private sector firms in the production and delivery of inputs and better "targeting" of subsidies to farmers with the commercial potential to make productive use of them.³⁰ Indeed, some FISPs have begun to shift to loan schemes and other sorts of approaches managed by the private sector.

Whatever AGRA's formal position has been on input subsidies, there is no question the organization's goals have been strongly supported by most FISPs. They represent a large subsidy directed explicitly at the inputs AGRA is promoting.

²⁹ Data are from 2010 and 2011 from T.S. Jayne and Shahidur Rashid, "Input Subsidy Programs in Sub-Saharan Africa: A Synthesis of Recent Evidence," *Agricultural Economics* 44, no. 6 (November 2013): 547–62, <https://doi.org/10.1111/agec.12073>.

³⁰ AGRA, "Feeding Africa's Soils" (Nairobi, Kenya: AGRA, 2019), <https://agra.org/wp-content/uploads/2019/11/FeedingAfrica%E2%80%99sSoils.pdf>.

Assessing Impacts

In the absence of more specific data from AGRA on its beneficiaries and its impacts on their productivity, incomes, and food security, it is reasonable to use national-level data as a strong indicator of AGRA's impacts. AGRA claimed it would double incomes and productivity for 30 million smallholder households, nine million directly and 21 million indirectly. Depending on the estimates used, the total represents a clear majority of smallholder households in AGRA countries.³¹ Thus, national-level data seems an appropriate indicator of AGRA's progress.³²

Impact 1: Limited number of beneficiary farmers

From the available data, it is difficult to determine how many farmers are actually benefiting from AGRA and whom those farmers are. AGRA's own reports suggest very limited reach in terms of "direct beneficiaries." Annual country reports refer to farmers "committed," without defining what that means. AGRA's most recent progress report, for the period 2007-16, is indicative of the reporting gap. Most detail focuses on seed varieties developed and commercialized, or tons of fertilizer sold. Farmers are listed mainly as benefiting from training in ISFM techniques – Integrated Soil Fertility Management – AGRA's term for its technology package. The report lists "5.3 million farmers with knowledge of ISFM," and "1.86 million farmers using ISFM." But there is no accounting for what technologies they are actually using and what benefit is accruing to those farmers.³³

For a program that has spent half-a-billion dollars with the goal of reaching nine million farmers directly, and another 21 million indirectly, a report of fewer than two million farmers "using ISFM" is a poor outcome.

ISFM in theory and practice

AGRA defines the goal of its Soil Health Program and subsequent soil fertility efforts as advancing the adoption of Integrated Soil Fertility Management (ISFM) practices. On paper, such practices go beyond the simple adoption of high-yield commercial seeds and inorganic fertilizer. ISFM has been defined as a tiered set of practices that farmers using local seeds and no external inputs can adopt to increase their yields in a sustainable way.³⁴ The stages of adoption are clear:

1. Promote the adoption of high-yield seeds and inorganic fertilizer to boost productivity on farms where soils are degraded.

³¹ Sarah K. Lowder, Jakob Skoet, and Terri Raney, "The Number, Size, and Distribution of Farms, Smallholder Farms, and Family Farms Worldwide," *World Development* 87 (November 2016): 16–29, <https://doi.org/10.1016/j.worlddev.2015.10.041>.

³² Some African governments carry out household surveys that can offer more useful data. But because not all AGRA countries do such surveys, with consistent time-series data, we only use such data to supplement this analysis.

³³ AGRA, "AGRA Annual Progress Report, 2007-2016."

³⁴ B. Vanlauwe et al., "Integrated Soil Fertility Management: Operational Definition and Consequences for Implementation and Dissemination," *Outlook on Agriculture* 39, no. 1 (March 1, 2010): 17–24, <https://doi.org/10.5367/000000010791169998>.

2. Work with farmers to add organic matter and other soil-building practices such as crop rotations of legumes with maize, explicitly in order to increase crop response to inorganic fertilizer.
3. Build knowledge among farmers to allow them to more effectively manage their inputs and crops to build soil health.

AGRA trainings for farmers may well include all these elements. There is some indication AGRA has pushed back against the monocultures subsidized by government input programs, advocating for subsidized legume seeds and the promotion of crop rotations. In practice, there is very little evidence Green Revolution promotion goes much beyond step-one promotion of high-yield seeds and fertilizers.

Because commercial seeds are rarely bred to be grown in intercropped fields, their adoption tends to result in monocultures. The ISFM recommendation to address the problem of nutrient-mining from monocropping is to rotate a leguminous crop with maize. This ignores the economic realities faced by many smallholder farmers who do not have enough quality land to give up maize for a season in favor of pigeon peas or another legume. Intercropping is the time-tested way to avoid nutrient-mining while diversifying crops and diets, but it is largely incompatible with the input-intensive practices advocated by ISFM proponents.

In any case, adoption rates have been low for the complete suite of ISFM practices. Evaluations of AGRA's ISFM trainings have found little impact on farming practices and even where farmers have adopted recommended practices they have seen little improvement in yields or incomes.³⁵ One researcher showed, in fact, that the benefits of going beyond the adoption of commercial seeds and fertilizers with organic soil-building practices would more than justify the cost, but still the adoption of the full integrated ISFM package rarely happened.³⁶ Three things are clear:

- In practice, AGRA's ISFM is largely limited to commercial inputs.
- Seed and fertilizer companies certainly benefit from the promotion and subsidization of their products, but they have little interest in the promotion of organic practices that can improve soil fertility and decrease the need for inorganic fertilizers.
- AGRA does not promote efforts to improve organic practices through intensive, scientific application of agroecological principles, which have been shown in a wide variety of contexts to raise yields in a sustainable and affordable way. AGRA assumes that farmers' seeds, soils, and practices are poor.

Mid-scale farmers benefiting more than smallholders

³⁵ Kwaw Andam, Simrin Makhija, and David Spielman, "Evaluation Of The Impacts Of A Soil Fertility Training Project On Farm Productivity In The Volta Region Of Ghana," 2019, <https://developmentevidence.3ieimpact.org/search-result-details/impact-evaluation-repository/evaluation-of-the-impacts-of-a-soil-fertility-training-project-on-farm-productivity-in-the-volta-region-of-ghana/7709>.

³⁶ Ephraim Nkonya, "The Unholy Cross: Profitability and Adoption of Soil Fertility Management Practices in Sub-Saharan Africa | IFPRI : International Food Policy Research Institute," accessed March 18, 2020, <https://www.ifpri.org/publication/unholy-cross-profitability-and-adoption-soil-fertility-management-practices-sub-saharan>.

There is no evidence from national-level data that a large share of smallholder farmers is directly benefiting from AGRA. Evidence would suggest that the main beneficiaries are likely not the poorest or most food-insecure farmers but rather a growing number of medium-scale farmers who have access to more land and are already integrated into commercial networks. Such farmers are far more likely to be men, which also undercuts the intended anti-poverty impacts of AGRA given the prevalence of poverty among women and their role in ensuring household food security.

Given the financial outlays involved in adopting the Green Revolution technology package, the focus on commercial farmers is not surprising. In fact, a recent AGRA report touted the success of this “hidden middle” in African agriculture.³⁷ A comprehensive academic analysis across several countries documented the nature of such “emergent farmers,” and the authors noted with some caution that it would be a mistake to assume that the success of this relatively small sector of farmers would lead to the sorts of productivity and income improvements such as those promised by AGRA. Only a fraction of such farmers even come up from the ranks of smallholders; many are new investors in farming from urban elites. The authors note that a tiny fraction of smallholders are likely to become emergent farmers, and they urge African governments and development agencies to prioritize the dissemination of appropriate technologies to low-income farmers to promote long-term agricultural and social development.³⁸

Impact 2: Limited productivity improvements

Table 1 shows the percentage growth in production, harvested area, and yield aggregated for the 13 AGRA countries over a 14-year period. We use the three-year averages for 2004-6 as the pre-AGRA baseline from which to gauge progress. We use the most recent data available to assess that progress, using three-year averages for 2016-18. The three-year averages smooth some of the annual fluctuations common in agriculture due to weather or other variations. We treat the period under review as a 12-year span of time from a pre-AGRA baseline to one that goes through 2018. We include production, area, and yield because all are relevant to any evaluation of agricultural intensification, which is intended to increase production on existing lands by increasing productivity. Appendix 2 includes the same data for each of the 13 AGRA countries we include in this study.

³⁷ AGRA, “The Hidden Middle: A Quiet Revolution in the Private Sector Driving Agricultural Transformation” (Nairobi, Kenya, 2019), <https://agra.org/wp-content/uploads/2019/09/AASR2019-The-Hidden-Middleweb.pdf>.

³⁸ T. S. Jayne et al., “Africa’s Changing Farm Size Distribution Patterns: The Rise of Medium-Scale Farms,” *Agricultural Economics* 47, no. S1 (2016): 197–214, <https://doi.org/10.1111/agec.12308>.

Table 1

AGRA: Limited Signs of Green Revolution			
% Growth, selected crops, 13 AGRA Countries			
2004-6 to 2016-18			
	Production (MT/year)	Area (hectares)	Yield (MT/hectare)
Maize	87	45	29
Rice (paddy)	163	87	41
Wheat¹	93	28	51
Millet	-24	-5	-21
Sorghum	17	13	3
All Cereals	55	22	27
Cassava	42	51	-6
Roots/tubers (all)	42	51	-7
Pulses (all)	80	19	51
Groundnuts	17	52	-23
Soybean²	58	35	18

Source: FAOSTAT for 13 Alliance for a Green Revolution in Africa countries: Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Tanzania, Uganda, Zambia.

¹excluding Burkina Faso and Ghana

²excluding Ghana, Mozambique, and Niger

This table shows, for example, that over the 12-year period in which AGRA operated, from 2004-6 to 2016-18, maize production in the 13 countries increased 87%, a figure that would indeed be on track to result in a doubling (100%) of production by 2020.

But that production gain was due more to a 45% increase in area harvested than it was to yield increases, which improved only 29%. We highlight the yield column because that is the metric AGRA and related Green Revolution programs promised to double by 2020. (To be on track to achieve a 100% increase in yield by 2020 the growth through 2018 would need to be 85-90%.)

As the table shows, there is no sign of impressive productivity growth in any major food crops sufficient to meet AGRA's goal of doubling yields. Rice, a staple in only a minority of AGRA

countries, showed large production increases, with output more than doubling (+163%). But as with maize, this owed less to productivity improvements, which grew only 41%, than to bringing new land into rice production, as harvested area increased a remarkable 87%. Wheat, the third major global cereal crop, showed slightly more dynamic productivity growth, but still only 51%. Ethiopia is the only AGRA country that depends heavily on wheat.³⁹ Overall, cereals production grew 55%, but yields grew just 27% with harvested area increasing 22%.

These data suggest that AGRA and other Green Revolution programs have thus far failed to deliver the promised productivity boom in AGRA countries. In fact, we see indications less of an intensification of African agriculture than an *extensification* onto new lands. The data show clearly that maize support programs are increasing total production of maize far more through extensification than productivity improvements. Some countries, such as Zambia, have nearly doubled the area planted to maize with all the Green Revolution incentives to plant the crop, yet their productivity growth over the 12-year period is just 27%.

This is not surprising. Ten of AGRA's 13 countries have input subsidy programs that support favored crops with discounted seeds and fertilizers. In most countries the favored crop is maize, which is one of the major staple food crops in many AGRA countries. It has been well-documented that subsidies for a given crop encourage farmers to plant more of that crop. Those with access to additional land have incentives to cultivate that land with that subsidized crop. In

³⁹ Data for each country are presented in the statistical appendix.

some countries, such as Zambia, some farmers also receive subsidized prices from the government, increasing the incentives to bring new land into maize cultivation.⁴⁰

The promotion of extensification rather than intensification is a serious contradiction for Green Revolution proponents. Their promise is to increase production on existing lands so as not to expand the environmental footprint of agriculture by bringing new lands into cultivation. The explicit goal of “sustainable intensification” is to minimize pressure on land and water resources while limiting further greenhouse gas emissions. To the extent AGRA and other Green Revolution programs are encouraging extensification, they are at odds with national and donor government commitments to mitigate climate change. Depending on individual AGRA country’s land endowments, extensification can be a serious problem. Rwanda, for example, is densely populated and does not have vast tracts of uncultivated arable land.

FISPs, and many related Green Revolution initiatives, also encourage farmers to plant monocultures. Over time such single-cropping depletes soils, and while inorganic fertilizer temporarily boosts yields it also can gradually undermine soil fertility, increasing acidity. As a result, yields can plateau, initially increasing with inorganic fertilizer and commercial seeds but flattening out and even declining in the absence of increased fertilizer applications.⁴¹ Because most smallholders cannot afford unsubsidized fertilizers, they often lose what short-term gains they saw from the subsidized Green Revolution technology package.

Decline or stagnation in traditional food crops

One of the negative consequences of the Green Revolution focus on maize and other commodity crops is the declining importance of nutritious and climate-resilient crops like millet and sorghum, which have been key components in healthy diets. These are rarely supported by FISPs or AGRA; meanwhile, input subsidies and supports for maize and other favored crops provide incentives for farmers to decrease their cultivation of traditional food crops. As Table 1 shows, millet production has fallen 24% in the AGRA period, with a 5% drop in area planted and a 21% decline in yields. Sorghum is another traditional staple that has stagnated under the Green Revolution. Production grew just 17% as yields stagnated (3%) and area harvested increased only 13%.

Before AGRA nearly twice as much land was planted in both millet and sorghum than was planted in maize. Now, maize dwarfs both due to the many incentives to produce the crop despite the demonstrated climate-resilience of these traditional crops. In this sense, AGRA and other Green Revolution programs are undermining farmers’ ability to adapt to climate change.

Other critical food security crops suffered as well. Cassava, a key staple in Nigeria, Mozambique, Uganda, Tanzania, and many other AGRA countries, saw a 6% decline in yields.

⁴⁰ For a full explanation of Zambia’s maize policies, see Chapter 4 in Timothy A. Wise, *Eating Tomorrow: Agribusiness, Family Farmers, and the Battle for the Future of Food* (The New Press, 2019).

⁴¹ Antony Chapoto, Darlington Sabasi, and Collins Asante-Addo, “Fertilizer Intensification and Soil Fertility Impact on Maize Yield Response in Northern Ghana,” *2015 AAEA & WAEA Joint Annual Meeting, July 26-28, San Francisco, California*, 2015 AAEA & WAEA Joint Annual Meeting, July 26-28, San Francisco, California (Agricultural and Applied Economics Association, 2015), <https://ideas.repec.org/p/ags/aaea15/205694.html>.

Overall, roots and tubers, which include nutritious traditional crops such as sweet potatoes, experienced a 7% decline in yields. Groundnuts, another critical staple source of protein in many countries, saw an alarming 23% drop in yields.

Maize: Minimal gains in AGRA’s priority crop

Maize has been a priority crop for AGRA, and the crop most heavily supported by governments and donors through input-subsidy and other programs. Yield growth of 29% for maize across

Table 2

Maize Growth Under AGRA				
Change in production, area, yield 2004/6 - 2016/18				
	Production (MT/year)		Area	Yield
	2016/18 Avg	%	%	%
AGRA Total		87	45	29
Nigeria	10,707,669	72	64	7
Ethiopia	7,774,721	115	24	71
Tanzania	5,947,674	59	38	15
Kenya	3,512,926	26	31	-4
Mali	3,082,573	414	213	63
Zambia	2,958,169	153	99	27
Uganda	2,882,421	142	48	64
Malawi	2,843,864	57	6	51
Ghana	1,997,765	70	35	26
Mozambique	1,615,084	42	9	27
Burkina Faso	1,612,028	125	128	0
Rwanda	380,988	305	146	66
Niger	35,301	341	234	53

Source: Authors calculations using data from FAOSTAT, <http://www.fao.org/faostat/en/#data/QC>, downloaded January 2020

Notes: 2004-2006 3 year average; 2016-2018 3 year average. Percent change between 2004-6 and 2016-18 3-year averages. Countries are listed in order of total Maize production.

AGRA countries is well below the stated goal of doubling productivity, which would represent a 100% increase by 2020. (With average yield growth of just 2.5% per year for the 12-year period we document, yields would be only about five percentage points higher in 2020 after two more years of yield growth). Annual maize yield growth rates before AGRA averaged 1.0% per year across all AGRA countries, so more recent growth rates have increased. But they are well short of any sort of transformative productivity revolution.

Table 2 shows the production, area, and yield growth for maize in all AGRA countries. Only in Ethiopia do we see the sort of productivity-driven growth in production promised by the Green Revolution. Yields increased 71% in Ethiopia. Rwanda, Uganda, and Mali also showed stronger-than-average yield growth.

But several of Africa's top maize producers have shown surprisingly weak productivity improvement given

the levels of support provided by FISPs, AGRA, and other programs:

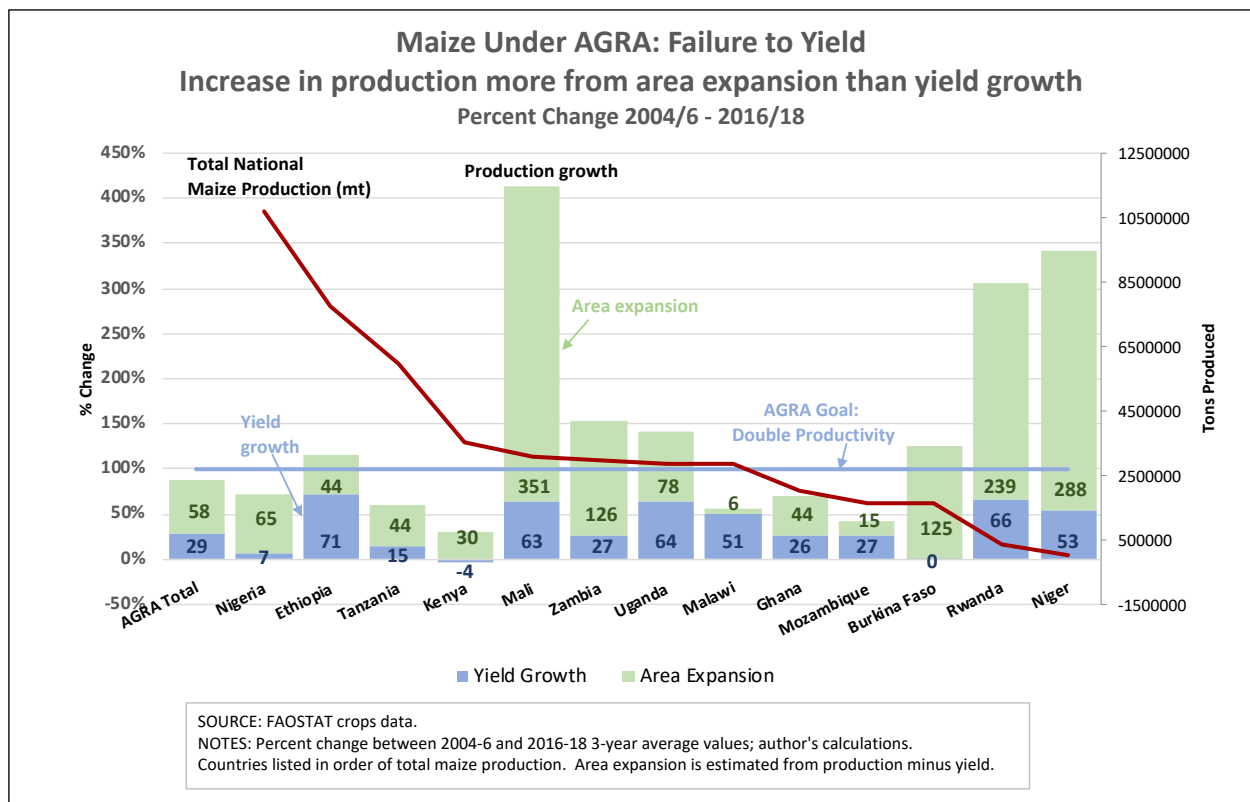
- Nigeria, the largest maize producer among AGRA countries, saw a minimal increase in yields under AGRA compared to 2.5% annual yield growth before AGRA.⁴² Production increased significantly primarily because of an 81% increase in land planted to maize.
- Kenya, the fourth largest maize producer, saw yields actually decline under AGRA, after posting 1.7% average annual yield growth in the nine-year period before AGRA's arrival.

⁴² Pre-AGRA period compares three-year periods 1997-99 and 2004-6, calculating compound annual yield growth from data from FAOSTAT.

- Tanzania, the third largest maize producer, also showed tepid yield growth of just 15%, barely more than 1.0% per year.
- Zambia, AGRA's sixth largest maize producer, posted just a 27% increase in maize yields, an annual average of 2%; yield growth before AGRA was much higher, 4.2% per year.

This means that among AGRA's top six maize producers, only Ethiopia and Mali showed significant yield growth that surpassed pre-AGRA yield growth rates. This is a poor result for one of AGRA's priority crops in some of its most important countries. Because maize is the crop most often supported by input subsidies, poor productivity results suggest that such Green Revolution programs are failing even when they get massive levels of government support.

Figure 1



The data show clearly that maize support programs are increasing total production of maize far more through extensification than productivity improvements. Figure 1 shows the percentage increase in maize production, which has nearly doubled for AGRA countries as a group (bar on far left). Seven countries have at least doubled production. But AGRA's goal was not to double production, it was to double productivity. The blue area shows the much lower increase that came from productivity. For AGRA as a whole that is only a 29% increase. The larger green portion of the bar indicates the growth in production from other sources, mainly the area planted to maize. None of the seven countries that has doubled production will reach AGRA's goal of doubling productivity, indicated by the horizontal blue line. Some, such as Zambia, have nearly

doubled the area planted to maize with all the Green Revolution incentives to plant the crop, yet their productivity growth over the 12-year period is just 27%. The countries are listed in order of total maize production. As the graph shows, some of the worst performers are the largest producers.

Measuring productivity gains comprehensively

One of the negative impacts of AGRA, FISPs, and Green Revolution promotion programs is their narrow focus on maize and a few other priority crops. Productivity gains even for those crops have been disappointing. How can we better assess the overall impact of Green Revolution programs on the productivity of staple crops as a whole, not just the favored crops?

To estimate this more comprehensive measure of food crop productivity, we used national-level data to estimate the yield growth during the AGRA years for four important staple crops in each country. We included maize, millet, sorghum, and the broad category of “roots and tubers,” which includes cassava, sweet potato, and other key staples. For countries in which another grain is a key staple (e.g., teff in Ethiopia, rice in Nigeria and Tanzania), we used “cereals, total” with “roots and tubers.” We created one index by weighting the yield growth for each crop based on area harvested (in 2017), a good measure of the prevalence of the crop. The resulting “Staple Yield Index” gives a more comprehensive picture of overall productivity growth for a range of key food crops over 12 years of AGRA’s programming.

Table 3

AGRA: Productivity	
% Change in Staple Yields 2004/6 - 2016/18	
AGRA TOTAL	18
Burkina Faso	-10
Ethiopia	73
Ghana	39
Kenya	-7
Malawi	50
Mali	19
Mozambique	30
Niger	36
Nigeria	-8
Rwanda	24
Tanzania	22
Uganda	0
Zambia	20
Source: FAO	
Staple Yield Index: weighted yield increases for maize, millet, sorghum, roots/tubers. For AGRA total, Ethiopia, Nigeria, and Tanzania - cereals plus roots/tubers.	

As Table 3 shows, no country is on track to reach the goal of doubling productivity. Only Ethiopia and Malawi show staple crop yield growth as high as 50% for the AGRA period. Three countries – Burkina Faso, Kenya, and Nigeria – show declines in productivity for this basket of staple crops.

Rwanda, which AGRA touts as one of its greatest success stories, registers staple yield growth of just 24%, less than 2% per year. This is because Rwanda’s relative success in raising maize yields (+66%) is offset by stagnant yields for sorghum (0%), which before AGRA was a more important staple than maize. Yields also declined for rice. Perhaps most significant, yields for “roots and tubers,” which include the important staple crops of cassava and sweet potato, increased only 6% over the 12-year AGRA period. The Staple Crop Index shows that Rwanda’s apparent success in maize has come at the expense of more comprehensive food crop productivity.

Limited technology adoption

Data on fertilizer use, reported in Table 4, show that AGRA countries are unevenly progressing toward the goal agreed by African governments in 2006 in Abuja to increase fertilizer applications to 50 kg/ha of arable land.

Of AGRA countries, only Zambia had achieved the 50 kg/ha goal, with input subsidies and other policies raising fertilizer use by 129% in ten years. Rwanda and Mozambique registered large percentage gains in use, but they started from a very low base. Ethiopia’s 82% increase in fertilizer use was significant, underpinning its aggressive Green Revolution programs. AGRA acknowledges that fertilizer subsidies account for much of the adoption. “In 2016, subsidized fertilizers accounted for 12% of the total volume used in Zimbabwe, 28% in Malawi, 69% in Burundi, 92% in Rwanda and 100% in Ethiopia (IFA and IFDC 2017)” (emphasis added).⁴³

Reliable data on the adoption of the kinds of high-yield seed varieties promoted by AGRA, FISPs, and other Green Revolution programs are difficult to obtain. Given that this is one of AGRA’s most important goals, it is unfortunate that the organization does not report adoption rates among farmers in its target countries. AGRA more commonly reports increases in the domestic production of new seed varieties and the growth in agro-dealer networks that can make those varieties available to farmers. Neither indicator provides an accurate gauge of whether farmers are adopting those varieties. AGRA reports “farmers using ISFM,” which may or may not include the adoption of the sorts of high-yield seed varieties the organization is developing and promoting.

⁴³ AGRA, “Feeding Africa’s Soils,” 119–20.

Table 4

Fertilizer use under AGRA			
	Fertilizer use (kg /ha of arable land)^a		
	3-YR AVG	3-YR AVG	Change
	2004-06	2014-2016	%
Burkina Faso	13.7	17.9	31
Ethiopia	10.8	19.6	82
Ghana	13.1	20.0	53
Kenya	31.7	26.0	-18
Malawi	33.9	29.5	-13
Mali	28.4	33.4	18
Mozambique	2.8	7.6	173
Niger	0.4	0.6	62
Nigeria	7.3	8.0	10
Rwanda	2.8	14.1	398
Tanzania	5.5	10.0	82
Uganda	1.2	2.0	62
Zambia	27.9	63.9	129
AGRA	13.8	19.4	41

Source: Author's calculations using data from World Bank Data, downloaded Feb 2020.

Note: Fertilizer consumption includes nitrogenous, potash, and phosphate fertilizers (including ground rock phosphate) but does not include animal and plant manures.

If Zambia is any indication, input subsidies are likely the key to increasing adoption rates. Since its FISP went into effect in 2002, Zambia saw a 70% increase in fertilizer use and an 80% increase in the use of commercial maize seeds. But many Zambian farmers were excluded from the FISP, which was available only to farmers with more than one hectare of land. Larger-scale commercial farmers were the ones benefiting from both FISP and the Zambian government's purchases of maize at above-market prices. Without access to subsidized inputs, few smallholders were adopting the Green Revolution package.⁴⁴ Malawi's FISP, which was more inclusive of smallholders, managed to increase the use of commercial maize seed to nearly 50%, but that share has fallen as fiscal pressures have reduced Malawi's budget for the subsidy program resulting in cuts to the number of beneficiaries.⁴⁵

Without subsidies, the Green Revolution technology package often doesn't pay for farmers. The African Center for Biodiversity estimated that in Malawi seeds and fertilizers cost three times the value farmers could gain from the small maize yield increase, assuming the farmer can afford to sell all of the added production.⁴⁶ Many can't; their families need to eat. For many smallholders, the Green Revolution package is just too expensive, which is why input subsidies have been critical to achieving what limited adoption has been achieved.

Overall, these aggregate data suggest that AGRA and related Green Revolution programs are failing to bring a productivity revolution to AGRA countries. Yields are improving not nearly fast enough to achieve the goal of doubling productivity by 2020. Yield gains are surprisingly poor for heavily supported crops such as maize. More worrisome, yields have actually declined for three key food crops – millet, cassava, and groundnuts – and they have stagnated for sorghum.

⁴⁴ Antony Chapoto and Brian Chisanga, "Zambia: Agriculture Status Report 2016" (Lusaka, Zambia: Indaba Agricultural Policy Research Institute, 2016), 15–16, 20, <http://www.iapri.org.zm/images/TechnicalPapers/IAPRI-Booklet.pdf>.

⁴⁵ For a detailed discussion of Malawi's FISP, see: Wise, *Eating Tomorrow*, 15–48.

⁴⁶ "Running to Stand Still: Small-Scale Farmers and the Green Revolution in Malawi" (Melville, South Africa: African Centre for Biodiversity, September 2014), <http://acbio.org.za/wp-content/uploads/2015/02/Malawi-running-to-stand-still.pdf>.

In fact, the AGRA period can best be characterized not by intensification but by extensification as FISP and other incentives have brought large quantities of new land into production. For the critical food crops analyzed here, total area harvested went up 27% across AGRA countries. For nearly all crops, increased area was far more responsible for production increases than was yield growth.

Impact 3: No evidence of doubling incomes or halving food insecurity

AGRA offers little evidence that beneficiary farmers' incomes are increasing, never mind whether they are doubling. In fact, it is difficult to find anything but anecdotal reporting of farmers' welfare improving with AGRA's interventions. Again, this is disturbing for an international nongovernmental organization that has received and distributed such large sums in the name of productivity-led welfare improvements.

In the absence of such data from AGRA, we examine the available national indicators related to poverty and food insecurity for AGRA countries. Relying primarily on World Bank and FAO data, we see limited and uneven progress in reducing food insecurity, weak progress in reducing poverty, and continued high rates of rural poverty where one would expect AGRA's interventions to have the greatest impact – by increasing smallholder incomes.

Table 5 shows the latest FAO data on hunger. It includes data over time (pre-AGRA to 2018) for “undernourishment,” which can best be interpreted as a measure of extreme food deprivation. We show the change during the AGRA period in both the absolute number of chronically hungry and the change in the “prevalence of undernourishment,” the share of the population suffering chronic hunger. We also include FAO's more recent measure of “Moderate and Severe Food Insecurity,” which was developed to supplement the undernourishment measure by using household surveys to estimate the number and share of people who experience some level of food insecurity. (Because it is a new measure, the data are not available for all countries.)

There is no evidence that AGRA countries are reducing food insecurity in any generalized way. The results are, in fact, alarming. The total number of severely undernourished in AGRA countries has increased from 100.5 million to 131.3 million, a 30% increase, from before AGRA to 2018. Only Ethiopia reports a significant decline in the absolute number of chronically hungry residents. Nigeria and Uganda account for a large share of the increase in undernourishment, with the number more than doubling in each country over the 12-year period.

Table 5

Rising Hunger in AGRA Years Undernourishment 2004-06 to 2016-18								
	Number Undernourished (Millions)			Prevalence of Undernourishment (%)			Moderate and Severe Food Insecurity 2016-18	
	2004-06	2016-18	Change (% points)	2004-06	2016-18	Change (% points)	Millions	Prevalence (%)
Burkina Faso	3.3	3.8	0.5	24.9	20.0	-4.9	*7.4	*40.7
Ethiopia	30.5	21.6	-8.9	39.7	20.6	-19.1	-	-
Ghana	2.0	1.6	-0.4	9.3	5.5	-3.8	14.3	49.6
Kenya	10.2	14.6	4.4	28.2	29.4	1.2	28.1	56.5
Malawi	3.4	3.3	-0.1	26.1	17.5	-8.6	15.3	81.9
Mali	1.4	1.2	-0.2	11.1	6.3	-4.8	-	-
Mozambique	7.8	8.3	0.5	37.0	27.9	-9.1	20.4	68.6
Niger	2.1	3.6	1.5	15.1	16.5	1.4	**17.8	**83
Nigeria	9.1	25.6	16.5	6.5	13.4	6.9	-	-
Rwanda	4.0	4.5	0.5	44.5	36.8	-7.7	-	-
Tanzania	13.6	17.6	4.0	34.4	30.7	-3.7	39.7	69.3
Uganda	6.9	17.6	10.7	24.1	41.0	16.9	-	-
Zambia	6.2	8.0	1.8	51.1	46.7	-4.4	-	-
Total	100.5	131.3	30.8					
SSA	177.3	229.9	52.6	24.3	22.5	-1.8	595.3 ⁺	58.2

Source: FAOSTAT Food Security Indicators, <http://www.fao.org/faostat/en/#data/FS>, updated October 2019
*2014-2016 average **2015-2017 average
⁺This is an increase from 494.3 in 2014
- Indicates no data

Several AGRA countries posted improvements in the share of their populations suffering undernourishment, indicating progress in reducing the rate if not the number of hungry. But in four countries – Kenya, Niger, Nigeria, and Uganda – the share as well as the number increased. For Sub-Saharan Africa as a whole, the number of severely malnourished increased by more than 50 million, to 230 million people, while the share went down only slightly, from 24.3% to 22.5%.

For those who would take comfort in the incremental improvements in the share of chronically hungry, the new FAO measure of moderate and severe food insecurity offers considerable caution. For Sub-Saharan Africa as a whole, nearly 600 million people are considered food insecure, a number that increased more than 100 million just since 2014. That leaves an estimated 58% of Africans food insecure.

We do not have the data to estimate overall food insecurity for AGRA countries as a group, but for the countries that report data the situation is alarming. Ghana reports just 5.5% of its people suffering severe hunger, but nearly half report food insecurity. Kenya's rates go up from 29% to 57%, while Tanzania's already alarming rate of undernourishment (40%) increases to 69% when counting all people reporting food insecurity. Malawi, often cited as a Green Revolution success story, has an estimated 82% of its people suffering moderate to severe food insecurity.

Poverty: Declining but still high

National measures of rural incomes, which would best allow us to assess AGRA’s impacts on farmer incomes, are not readily available. Nor is rural poverty consistently tracked, with data spotty from different AGRA countries. For this reason, we use national measures of extreme poverty as a second-best measure of income improvements during the AGRA years.

Rural poverty tends to be significantly higher than urban poverty, so national poverty measures can be a misleading substitute in assessing progress on increasing rural incomes. Rural poverty data available for some AGRA countries suggest improvements in some but little improvement in others. Rates remained above 50% in Malawi, Niger, and Zambia,⁴⁷ with the latter reporting an alarming 78% rural poverty rate, a rate that has not improved despite Zambia’s dramatic increase in maize production.⁴⁸

Table 6

Change in Poverty Rate Under AGRA				
Poverty Rate at \$1.90/day (%)				
			Percentage Point Change	
	2006	2018	Under AGRA: 2006-18	Pre-AGRA: 1994-2006
Burkina Faso	59	35	-24	-24
Ethiopia	43	16	-27	-27
Ghana	24	9	-15	-14
Kenya	37	41	4	5
Malawi	69	73	4	3
Mali	51	24	-27	-34
Mozambique	73	58	-15	-14
Niger	64	46	-18	-17
Nigeria	56	55	-1	0
Rwanda	63	60	-3	-4
Tanzania	62	47	-15	-15
Urganda	51	40	-11	-12
Zambia	60	62	2	11

Source: ReSAKSS, 2019, <http://www.resakss.org/>
Note: Poverty line for extreme poverty, \$1.90 a day, in 2011 PPP.

Table 6 compares national poverty rates from 2006 and 2018 for AGRA countries based on the World Bank’s global threshold for extreme poverty (\$1.90/person/day). The data, which do not disaggregate rural and urban residents, show significant reductions in extreme poverty in a few AGRA countries. Notably, Ethiopia, Ghana, and Mali have cut the rates of extreme poverty by more than half. It is striking, however, that in none of these countries did poverty rates decline in the AGRA years more than they had in the previous 12-year period. (The data is included for comparison.) The comparison reveals no evidence of accelerated poverty reduction during the Green Revolution campaign of the AGRA years. The five AGRA countries in which poverty has increased, or barely decreased, from high levels are particularly troubling. In Kenya, Malawi, and Zambia, national poverty rates increased, while in Nigeria and Rwanda they remained virtually stagnant at 55% and 60% respectively. With Rwanda often cited as the model for AGRA’s Green Revolution approach, this is worrisome.

Overall, it is impossible to assess the progress in AGRA countries toward the goal of doubling farmer incomes for 30 million farmers. These data make clear, however, that there is little evidence that AGRA is making an appreciable impact on farmer incomes and food security.

⁴⁷ World Bank, World Development Indicators, Rural Poverty (2017).

⁴⁸ Antony Chapoto and Nicholas J. Sitko, *Agriculture in Zambia: Past, Present, and Future* (Lusaka, Zambia: Indaba Agricultural Policy Research Institute, 2015).

Given the limited number of farmers reached by the program and the small and uneven productivity gains registered for priority food crops, it is not surprising that few smallholder farmers are seeing welfare benefits from AGRA’s interventions or related Green Revolution programs.

AGRA’s results: Failure to yield, little benefit for small-scale farmers

On balance, as AGRA reaches its 2020 deadline for doubling the productivity and incomes of 30 million smallholder farm households while cutting hunger in half, the evidence shows that AGRA and the Green Revolution campaign of which it is a part are failing Africa’s smallholder farmers.

Figure 2

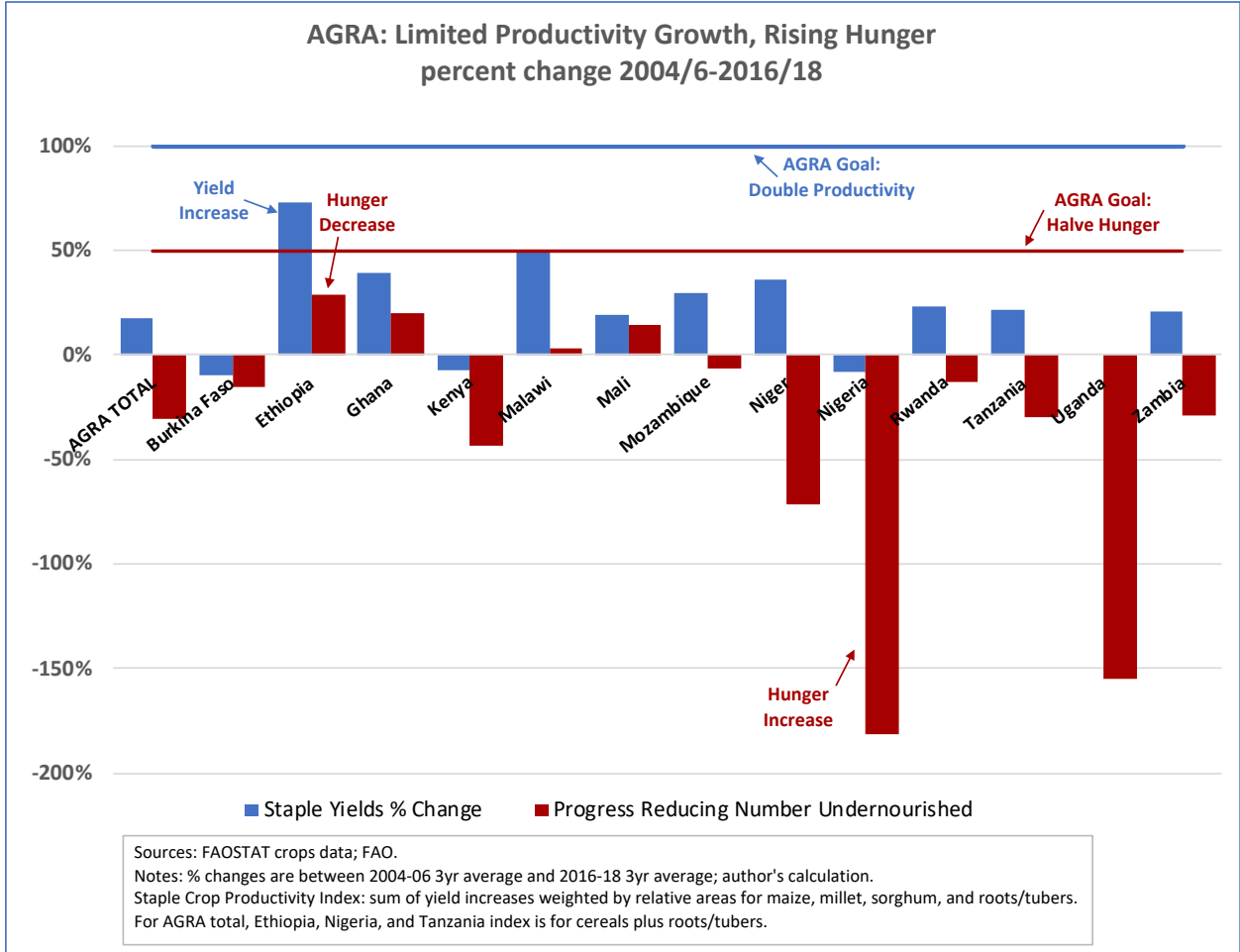


Figure 2 shows the two most revealing measures of productivity and welfare. The blue bars represent the Staple Yield Index, with the blue line at 100%, AGRA’s goal of doubling productivity. The red bars indicate the progress in reducing the number of undernourished people, with percentage reductions in undernourishment above the x axis and increases below it.

Only one country, Ethiopia, shows anything resembling the combination of yield growth and hunger reduction Green Revolution proponents promised, with a 73% increase in productivity and a 29% decrease in the number of hungry. Note, however, that neither of these is on track to meet AGRA's goal of doubling productivity and halving the number of hungry (which would be a 50% decrease). Ghana is the only other AGRA country that shows decent productivity growth with some decrease in hunger. Malawi achieved relatively strong yield growth but only a small reduction in undernourishment.

For AGRA countries as a group, the picture is grim through 2018: small yield increases for staple crops (+18%) and rising levels of hunger (+30%). Nine of AGRA's 13 countries show rising hunger levels. In Rwanda, AGRA's supposed success story, the number of hungry increased 13% on mediocre productivity increases of 24%.

Rwanda: AGRA's hungry poster child

Because Rwanda is often cited as AGRA's poster child, we examine briefly the data on productivity and hunger. The results are not as glowing as its reputation, which lifted Rwandan Agriculture Minister Agnes Kalibata to leadership in AGRA. AGRA can point to a four-fold increase in maize production, with 66% growth in maize yields, as evidence of success. Rice production nearly doubled in the AGRA years. But Rwanda's maize and rice boom has come at the expense of more nutritious and diverse small-scale agriculture, and the Green Revolution technology package has been imposed with a heavy hand.

Data show that while maize yields increased with fertilizer and seed subsidies, backed by measures to enforce their use, most of the growth in maize production came from a 146% increase in land planted to maize. Similarly, rice production doubled, but yields actually *declined* 19%, with land planted to rice increasing 147%. In this small, densely populated country, some of that land came out of other staple crops, with the government reportedly banning their cultivation in some areas. Sorghum, cassava, sweet potatoes, and other roots and tubers were more important food crops than maize before AGRA, providing nutritional diversity in addition to benefits to the land. Land in cassava fell 16%, while sorghum land declined 17%.⁴⁹

Our more comprehensive Staple Yield Index captures Rwanda's poor performance across all staple crops. Compared to the much-touted 66% increase in maize yields, we see just a 24% increase in yields for key staple categories – maize, millet, sorghum, roots and tubers.

This shift in cropping patterns was very much a Green Revolution intention. According to recent accounts, the Rwandan administration, with current AGRA head Agnes Kalibata leading the Ministry of Agriculture, imposed a strict regimen in which farmers were fined if they did not plant maize and other approved program crops.⁵⁰ This enforced planting regimen cut dramatically into traditional practices of intercropping and of growing a wider diversity of food crops. Farmers were compelled to use fertilizer, which the government heavily subsidized.

⁴⁹ Data for this section is from FAO. Country data for all AGRA countries are in Appendix 2 of this report.

⁵⁰ Neil Dawson, "Why the 'Green Revolution' Is Making Farmers Poorer in Rwanda," *The Conversation*, accessed March 20, 2020, <http://theconversation.com/why-the-green-revolution-is-making-farmers-poorer-in-rwanda-54768>.

Forced cooperative schemes mandated crop and even seed use for many farmers. But the government's Green Revolution campaign met resistance from farmers, many of whom were losing their land or were just refusing to plant. With President Paul Kagame facing an election in 2017, he relaxed some restrictions, and in recent years more diverse cropping has returned, though maize and other favored crops remain heavily subsidized and supported.⁵¹

In the AGRA period, extreme poverty remained high in Rwanda, falling only three percentage points to a still-alarming 60%. The prevalence of undernourishment went down nearly 8 points to 37%, but the absolute number of severely hungry increased by 500,000 Rwandans to 4.5 million. It is notable that Rwanda's poverty reduction was more effective in the 12 years before AGRA, when the number fell by 500,000 people. (See Table 5 on rising hunger.)

Far from being a Green Revolution success story, Rwanda offers an example of the ways in which the imposition of such a model on a relatively diverse farming landscape can disrupt more nutritious and sustainable cropping patterns. It is certainly not an advertisement for Africa's Green Revolution that staple yield growth was just 24% in 12 years while severe hunger increased by half-a-million people, even with a four-fold increase in maize production and a doubling of rice production.

Mali: Growing food, reducing hunger, and resisting AGRA

Mali presents a stark contrast to most other AGRA countries, and that may well owe to its government's more careful approach to widespread promotion of the Green Revolution technology package. Farmer and other non-governmental organizations actively mobilized to stop AGRA from imposing its model in Mali. Since democratic government was restored in the 1990s, farmers groups have played a role in government policy, even drafting the 2004 Agricultural Orientation Law, the country's overall agricultural framework. Mali's Coalition to Protect African Genetic Resources convened organizations from all over Africa to engage with AGRA and to dissuade governments from participating, launching a 2007 campaign "Agroecological Alternatives to AGRA."⁵² Mali's 2010 seed law recognized farmers' rights to seeds and a revision currently under consideration, written with the active involvement of farmer organizations, would enshrine those rights more firmly. This leaves farmers with greater sovereign control over the seeds and other inputs they choose to adopt.

AGRA operates in Mali but it has not had the same level of influence as in many other countries due to farmer and government resistance. Maize has been the priority crop, as in many other AGRA countries, with input subsidies supporting the crop's expansion. The area planted to maize has nearly tripled, and yields have increased significantly. But because Mali has low population densities and available uncultivated land, this has not come at the expense of traditional crops, as has occurred in other AGRA countries. Sorghum, millet, and pulses remain

⁵¹ An Ansoms, "The End of the New Green Revolution in Rwanda?," *ROAPE* (blog), February 11, 2020, <http://roape.net/2020/02/11/the-end-of-the-new-green-revolution-in-rwanda/>; An Ansoms, "Rwanda's Green Revolution," *ROAPE* (blog), October 18, 2017, <http://roape.net/2017/10/18/rwandas-green-revolution/>; An Ansoms, "Hunger in the Name of Development: Rwandan Farmers Under Stress," *ROAPE* (blog), March 8, 2018, <http://roape.net/2018/03/08/hunger-in-the-name-of-development-rwandan-farmers-under-stress/>.

⁵² InterPares, "Coalition Pour La Protection Du Patrimoine Génétique Africain (COPAGEN)."

the country's most important food crops, with sorghum and millet planted on three times the land now planted to maize. (See Appendix 2 for the cropping trends.)

Poverty and hunger have gone down dramatically. Extreme poverty was reduced by more than half since 2006, to 24%. The share of the population suffering chronic hunger went down from 11.1% to 6.3%. That progress may owe more to Mali's resistance to AGRA's Green Revolution policies and programs than to their implementation.

Alternatives to the Green Revolution

Since AGRA's founding in 2006, science and policy have advanced significantly, bringing to light the limitations of the input-intensive Green Revolution model of agricultural development and the viability of alternative approaches. This new literature was summarized and analyzed well in the report, "From Uniformity to Diversity," by the International Panel of Experts on Sustainable Food Systems, founded by former UN Special Rapporteur on the Right to Food Olivier De Schutter.⁵³ As the expert report makes clear, a range of sustainable agricultural practices that move away from chemical-intensive monoculture cropping can grow all the food the world needs to feed a growing population. They warn of "lock-ins" that are preventing the changes called for by a wide range of experts, from the IPCC to the FAO. They identify seven key lock-ins, including "path dependency," the tendency of economic systems to follow prescribed development paths which are then difficult to change.

AGRA seems to be feeding Africa's worrisome trend toward locking in path dependency on input-intensive agriculture, much to the detriment of smallholder farmers. A recent article in the journal *Food Policy* surveyed the results 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.⁵⁴

The vast majority of smallholders on the continent are not yet heavily reliant on such inputs, nor are they locked into production for value chains that require the large-scale production of uniform commodities. Unlike industrial-scale farmers in developed countries, their path has not yet been determined; there remain opportunities to chart paths different from the high-input agriculture model promoted by AGRA.

Agroecology is one of the systems giving farmers the kinds of innovation they need, farming with nature to promote the soil-building practices that Green Revolution practices often undermine. Multiple food crops are grown in the same field. Compost, manure, and biofertilizers – not fossil-fuel-based fertilizer – are used to fertilize fields. Biological pest control decreases pesticide use. Researchers work with farmers to improve the productivity of their seeds rather

⁵³ IPES-Food, "From Uniformity to Diversity: A Paradigm Shift from Industrial Agriculture to Diversified Agroecological Systems" (International Panel of Experts on Sustainable Food systems, 2016), http://www.ipes-food.org/_img/upload/files/UniformityToDiversity_FULL.pdf.

⁵⁴ 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>.

than replacing them with commercial seeds farmers need to buy every year and douse with fertilizer to make them grow.⁵⁵

The Alliance for Food Sovereignty in Africa (AFSA) has documented the effectiveness of agroecology, now widely promoted among its member organizations:⁵⁶

- In Kenya, farmers have created a network of community seed banks to identify, save, and distribute nutritious and productive varieties of local food crops, the kind being lost to the green revolution push.
- In Malawi women farmers identified 300 vegetables and planted them using permaculture techniques, a highly productive form of agroecology. This has improved their income, nutrition, and health considerably.
- In Tigray, Ethiopian farmers and local allies experimented with improving their land through soil and water conservation techniques. They fared much better than those using chemical-based fertilizers. They supplemented this using well-established push-pull biological pest control as well as other techniques and increased their income and improved their health. The program in Ethiopia is now accepted as government policy.

Such initiatives also achieve productivity increases more impressive than those achieved by Green Revolution programs. One University of Essex study surveyed nearly 300 large ecological agriculture projects across more than 50 poor countries and documented an average 79% increase in productivity with decreasing costs and rising incomes.⁵⁷ Such results far surpass AGRA's.

The recent expert report on agroecology from the FAO offers additional evidence and is clear in its call for a break with Green Revolution model. "Food systems are at a crossroads. Profound transformation is needed," the summary begins. It goes on to stress the importance of ecological agriculture, which supports "diversified and resilient production systems, including mixed livestock, fish, cropping and agroforestry, that preserve and enhance biodiversity, as well as the natural resource base."⁵⁸

⁵⁵ For a range of analyses, see: "Special Issue on Agroecology Transformations," *Agroecology Now!*, February 24, 2020, <http://www.agroecologynow.com/new-special-issue-on-agroecology-transformations-connecting-the-dots-to-enable-agroecology-transformations/>; IPES-Food, "Breaking Away from Industrial Food Systems: Seven Case Studies of Agroecological Transition" (IPES-Food, October 2018), http://www.ipes-food.org/_img/upload/files/CS2_web.pdf.

⁵⁶ For a robust set of case studies from across Africa, see: AFSA, "Case Studies – Agroecology," *AFSA* (blog), April 24, 2019, <https://afsafrika.org/case-studies-agroecology/>.

⁵⁷ J. N. Pretty et al., "Resource-Conserving Agriculture Increases Yields in Developing Countries," *Environmental Science & Technology* 40, no. 4 (February 2006): 1114–19, <https://doi.org/10.1021/es051670d>.

⁵⁸ HLPE, "Agroecological and Other Innovative Approaches for Sustainable Agriculture and Food Systems That Enhance Food Security and Nutrition."

Conclusions and Recommendations

The evidence suggests that AGRA is failing on its own terms. Its model of high-input agriculture is failing to reach large numbers of smallholder farmers. When it does reach farmers it is failing to significantly increase their productivity, and incomes are not increasing in a way that would reduce poverty and food insecurity. It is striking to find such limited evidence of impact when AGRA's initiatives are so heavily supported by African governments through input-subsidy programs.

Such failures call into question the premises of the Green Revolution model:

- **Will high-yield seeds and synthetic fertilizers be adopted by the majority of smallholders in Africa if they are made available to them?** No. AGRA has focused heavily on developing new seeds and improving their delivery through networks of agro-dealers. This does not seem to have achieved high adoption rates, even with inputs subsidized by governments. Only a small minority of smallholders have been reached.
- **Will those inputs, and related investments in marketing and financing, double yields on priority food crops?** No, there is little evidence that even where there has been adoption, thanks to input subsidies, yields have failed to increase so dramatically.
- **Will increased production give smallholder families a surplus they can sell on the market, allowing them to double incomes?** No, the yield increases have been small, and for many farmers added income from sales does not cover the costs of the inputs. The incentives to abandon more diverse cropping systems can actually undermine their food security by decreasing diet diversity and reducing climate resilience. Severe hunger in AGRA countries has increased 30%.
- **Can improvements be sustained over time?** No, temporary increases in yield from Green Revolution inputs tend to wane over time as soil fertility decreases under monocultures fed by synthetic fertilizers. Farmers grow dependent on input subsidies, which are declining under fiscal pressure. Meanwhile, they risk going into debt to pay for expensive inputs.

These failures implicate the Green Revolution model as an unsustainable and unaffordable path forward for African smallholders. While there may be medium-sized farms that could see productivity improvements with the adoption of Green Revolution technologies, these are overwhelmingly farmers – mostly men – with access to land, resources, and markets. Given the prevalence of hunger and poverty among the majority of smallholder families, African governments and supporting development agencies should transition their agricultural development programs to foster climate-resilient sustainable agriculture that prioritizes poverty reduction, cropping and diet diversity, and women's empowerment. These priorities are consistent with the latest science on climate change, nutrition, soil fertility, and smallholder-driven agricultural development. And they are the only way to ensure progress toward meeting the U.N. Sustainable Development Goals on ending hunger and poverty.

Based on our findings, we recommend that:

- AGRA and/or the Bill and Melinda Gates Foundation should publicly release any evaluations of AGRA they have carried out.

- Donor governments, in the interests of aid effectiveness, should:
 - carry out evaluations of AGRA to test and validate the findings here of limited impacts on smallholder farmers, and their productivity, incomes, and food security. Such evaluations should pay particular attention to the impacts on, or exclusion of, women.
 - Assess whether such support is consistent with national commitments toward climate mitigation and adaptation;
 - In the absence of evidence that contradicts the findings in this study, donors should consider suspending their financial support for AGRA.
- African governments should:
 - Evaluate the return on investment of Green Revolution programs, including input-subsidy programs.
 - Immediately transition their agricultural development programs away from policies that favor Green Revolution technologies toward a more robust array of policies that respond to smallholder farmers' expressed needs.
 - Incorporate agroecology and other sustainable smallholder systems into their National Climate Adaptation plans.
 - Protect the viability of informal farmer-managed seed systems from seed policy reforms that disproportionately favor commercial plant breeders.
 - Ensure that in all aid programs recipient governments are respecting the right to food and other international commitments, especially: the Voluntary Guidelines on Land Tenure, the Rights of Peasants, and the Farmers' Rights Treaty on seeds.

APPENDIX 1: The Alliance for a Green Revolution in Africa (AGRA)

AGRA is chartered as “an international non-profit, Non-Governmental Organization committed to ending hunger and promoting economic growth in Africa by improving the productivity and profitability of small-scale farmers.” Since its founding in 2006, AGRA has received nearly \$1 billion in contributions and disbursed \$524 million in grants in 18 countries through an evolving set of programs intended to promote the widespread adoption of commercial seeds and inorganic fertilizers with the stated goal of doubling agricultural productivity and incomes for 30 million smallholder farm households, nine million directly and 21 million indirectly.⁵⁹ AGRA also supports the development of policies and market structures that facilitate the adoption of such Green Revolution technology packages.

AGRA’s programs and priority countries have shifted over its 14-year history. Following are the main outlines of these developments based on AGRA’s published reports.⁶⁰

Table 7

AGRA Grants by Country, 2007-18			
	# Grants in 2018	\$ Grants 2018 (\$USD millions)	\$ Total 2007-18 (\$USD millions)
Burkina Faso	16	10.4	32.7
Ethiopia	10	15.5	34.2
Ghana	10	10.2	74.4
Kenya	8	6.4	55.3
Malawi	9	1.6	22.5
Mali	10	7.5	27.7
Mozambique	23	4.4	62.8
Niger**	-	-	6.3
Nigeria	8	9.0	25.0
Rwanda*	-	-	10.1
Tanzania	31	11.3	77.1
Uganda	5	2.7	34.3
Zambia**	-	-	12.4

Sources: AGRA "Annual Progress Report 2007-16," Annual Reports 2017 and 2018.

Notes: - indicates no data

*2017 # of grants; 2007-17 total; 2018 not available

**2016 # of grants; 2007-16; 2018 not available

⁵⁹ AGRA, “AGRA - What We Do - Grants,” AGRA, accessed May 14, 2020, <https://web.archive.org/web/20190406032154/https://agra.org/grants/>; AGRA, “Strategy Overview for 2017-2021: Inclusive Agricultural Transformation in Africa” (Nairobi, Kenya, n.d.), <https://agra.org/wp-content/uploads/2018/02/AGRA-Corporate-Strategy-Doc-3.-2.pdf>.

⁶⁰ Much of the information in this section is based on AGRA, “AGRA Annual Progress Report, 2007-2016.”

Priority countries – AGRA began with the intention to support work in 18 countries, but ongoing support was quickly reduced to 13 after South Sudan, Sierra Leone, Senegal, Democratic Republic of Congo, and Liberia were eliminated from the list. The remaining 13 countries, which are covered in this report, include: Burkina Faso, Ethiopia, Ghana, Kenya, Malawi, Mali, Mozambique, Niger, Nigeria, Rwanda, Tanzania, Uganda, and Zambia. Niger and Zambia were subsequently cut as priority countries, though Zambia has recently been included again. Support has varied greatly by country, with Tanzania getting the most support through 2018 (\$77.1m), followed by Ghana (\$74.4m). (See Table 7).

Priority programs, 2007-14 – In 2015 AGRA moved away from its original set of discreet programs toward a more “integrated approach” as part of its “agricultural transformation” agenda. For the bulk of its history, though, from 2007-14 it distributed \$414 million in grants under the following programs:⁶¹

- **Program for Africa’s Seed Systems (PASS)** – Founded at AGRA’s inception, PASS accounted for 44% of spending. The program supported the development of high-yield varieties (HYVs) of seeds in priority food crops and the markets and structures to promote their adoption by smallholders. Funds supported crop-breeding research, the development of national seed companies that could produce and distribute new seeds, and so-called agro-dealer networks to increase the delivery and availability of HYVs in the countryside.
- **Soil Health Program (SHP)** - AGRA’s other primary program in its early phase, SHP used 33% of AGRA’s grant funds to support the adoption of Integrated Soil Fertility Management (ISFM) practices among farmers. Support focused on training soil scientists and extension agents, training farmers, addressing constraints to farmers’ access to inorganic fertilizer, including support for agro-dealer networks. While ISFM involves a range of valuable soil-building practices in addition to the increased use of inorganic fertilizers, such as conservation agriculture techniques that can build organic matter in the soil, the principal focus of SHP was to increase the use of inorganic fertilizers by farmers. The widespread use of input-subsidies by governments provided financial incentives for such a focus.
- **Market Access Program (MAP)** – AGRA devoted 13% of funds to efforts toward market development for smallholders with projects to reduce transactions costs through bulk purchasing and selling of crop surpluses, increase value-addition, reduce post-harvest losses through improved storage and handling, and increase local demand and uses for staple crops. The program worked with farmer organizations to increase marketing and coordination. Because most farmer organizations tend to be dominated by or made up of larger-scale commercial farmers – mostly men – who grow and market surplus crops, the program tended to exclude smaller scale subsistence farmers.⁶²
- **Other early AGRA programs** – Smaller budgets supported three additional programs through 2014:

⁶¹ AGRA, “Progress Report 2007-2014” (Nairobi, Kenya: Alliance for a Green Revolution in Africa, March 2015), <https://agra.org/AGRAOld/wp-content/uploads/2016/04/agra-progress-report-20072014.pdf>.

⁶² KIT and AGRA, “Do All Roads Lead to Market? Learning from AGRA’s Market Access Programme” (Amsterdam and Nairobi: Royal Tropical Institute (KIT) and Alliance for a Green Revolution in Africa (AGRA), 2013), 125, http://www.mamud.com/Docs/Roads_to_market_web.pdf.

- **Policy and Partnership Program** – With 3% of AGRA funds, this program supported efforts to reform country policies to create a “business-friendly enabling environment,” such as reforms to seed policies.
- **Farmer Organization Support Center in Africa (FOSCA)** – Roughly 2% of AGRA’s funds went to support improved farmer organization in AGRA countries.
- **Innovative Finance Program** – The goal of this initiative, which received 1% of AGRA funds, was to develop new financing schemes for smallholders, small and medium-scale seed companies, and agro-dealer networks.

Current AGRA programs – Details on funding for the elements of AGRA’s more recent integrated Partnership for Inclusive Agricultural Transformation in Africa (PIATA) initiative are difficult to trace. AGRA was central to convening the African Green Revolution Forum (AGRF) in 2016, which took the lead from the Gates Foundation to recommit donors to Green Revolution promotion. The “Seize the Moment” fund drive netted a range of commitments from international agencies, private foundations, donor governments, and private companies totaling \$30 billion. Only a small fraction of that support is for AGRA, though it is difficult to trace those commitments.⁶³ The bulk of the funds come from:

- **African Development Bank (AfDB)** – \$24 billion over ten years to help finance the delivery of “modern agricultural technologies” to smallholders.
- **Private foundations** – Gates Foundation committed \$5 billion to “African development” (not just agriculture) over five years; Rockefeller Foundation pledged \$180 million heavily focused on reducing food loss and waste.
- **World Food Program** (\$120 million) and **International Fund for Agricultural Development** (\$3 billion over six years) for Africa programs.
- **Private companies** – Fertilizer firm OCP Africa (\$150 million over five years); Kenya Commercial Bank Group (\$350 million to support smallholders).

AGRA describes its integrated strategy in a 2017-2021 report.⁶⁴ It summarizes its post-2016 integrated programs in the following categories (as summarized on AGRA’s web site):

- **Policy and Advocacy** – Consulting with national and international institutions to advocate for seed policies, policies to encourage production and distribution of fertilizer, and reforms to subsidy policies to better “target” them to productive farmers, and other policies.
- **Agricultural Enterprises** – Supporting small and medium-sized African enterprises to allow smallholders “to improve production and access to markets to earn income from their surplus.” (AGRA also administers the Africa Enterprise Challenge Fund to spur business development.)
- **Inputs** – Improving access to “high-quality seeds and properly formulated fertilizers – mineral and organic,” and to train farmers in their use.
- **Markets** – Developing improved market access and opportunities for smallholders so they can get a good price for the crops, meet buyer demands for quality, and sell in bulk.

⁶³ AGRA, “More than US \$30 Billion Promised in Unprecedented Commitment to African Agriculture.”

⁶⁴ AGRA, “Strategy Overview for 2017-2021: Inclusive Agricultural Transformation in Africa.”

- **Process and Storage** – Encouraging smallholders to embrace “farming as a business” by improving smallholder access to value-added processing of goods while increasing and improving post-harvest storage.
- **Finance** – Increasing smallholder access to credit by encouraging financial firms to offer affordable and appropriate financing and supporting loan guarantee funds.

There is little indication that AGRA has increased its grantmaking since the “Seize the Moment” commitments. In fact, grants in 2017 and 2018 were down considerably compared to previous years, according to AGRA’s annual reports. Income from contributions was up, however, to nearly \$95 million in 2018. It is worrisome that AGRA that year spent almost as much on program management and administration (\$44.5 million) as it did on grants (\$48.4 million). The same high level of overhead was reported for 2017.⁶⁵ The remainder of AGRA’s budget in recent years has gone to program administration, including the Africa Enterprise Challenge Fund which supports African agribusiness initiatives, and to salaries, which in 2018 represented more than \$22 million, including \$310,000 for AGRA director Agnes Kalibata.⁶⁶

Donors – By far the largest donor to AGRA has been the Bill and Melinda Gates Foundation, which by 2018 had contributed a total of \$661 million dollars since AGRA’s inception.⁶⁷ AGRA does not publicly list donor contributions, it identifies only “funding partners” in its public documents. The 2018 Annual Report lists the Gates and Rockefeller Foundations along with USAID and UKAID as “PIATA Partners,” with “Other Partners” including: Regional agencies (AECF, AFAP, AfDB, African Union, NEPAD); International institutions (CIMMYT, FAO, WFP, IFAD, UNEP); Donors (German Cooperation, IDRC-Canada, NORAD, SIDA); a private company (Yara); Private foundation (Mastercard Foundation); Other partners (CTA, Farm to Market Alliance.)

AGRA’s most recent progress report, for the period 2007-16, is indicative of the limited reporting on the organization’s impacts, with no mention of numbers of beneficiaries, productivity increases, income increases, poverty reduction, or improved food security and nutrition.⁶⁸ It lists:

- **Research Capacity Building** – 151 PhDs Funded in crop breeding (followed by a range of other graduate students funded)
- **Research & Development** – 562 Varieties Released; 381 Varieties Commercialized
- **Input Production & Distribution** – 112 seed companies supported; 602,736 MT of seed produced; 39,934 Agro-dealers trained; 1.5m MT inorganic fertilizer sold through agro-dealers; 817 aggregation centres.

⁶⁵ In 2018, AGRA listed as expenses the following expenses: Direct Program (\$10.9m), Africa Enterprise Challenge Fund Management (\$8.9m), Program Support (\$15.7m), and Administration and Support (\$9.0m) for a total of \$44.5m, compared to \$48.4m in grants.

⁶⁶ ProPublica, “ALLIANCE FOR A GREEN REVOLUTION IN AFRICA - Form Form 990 for Period Ending Dec 2018 - Nonprofit Explorer,” ProPublica, accessed April 6, 2020, https://projects.propublica.org/nonprofits/display_990/980513530/12_2019_prefixes_94-99%2F980513530_201812_990_2019121716962428.

⁶⁷ From Bill and Melinda Gates Foundation grants database through 2017, tax filing for 2018.

⁶⁸ AGRA, “AGRA Annual Progress Report, 2007-2016.”

- **Awareness Creation on Agricultural Transformation** – 79,847 Lead farmers trained; 13, 199 extension agents trained in ISFM; 19,658 farmers organizations trained on ISFM; 873,238 farmers trained in storage and marketing; 5.3m farmers with knowledge of ISFM; 640,205 farmers trained in governance, group dynamics, and leadership.
- **Adoption** – 1.86m farmers using ISFM technologies; 1.49m hectares cropped with ISFM technologies.
- **Production Postharvest & Marketing** – 600,361 MT commodity aggregated at value of US\$177m; 760,233 farmers linked to sell to enterprises; 686,967 MT volume of commodities sold.

APPENDIX 2

AGRA: Assessing Progress Toward Goal of Doubling Productivity by 2020

Production, yield, and harvested area for select crops, 13 AGRA countries

Percent change pre-AGRA (2004-6 avg) to late AGRA (2016-18 avg)

			Maize	Rice, paddy	Wheat	Millet	Sorghum	Cereals, total	Cassava	Roots and Tubers, total	Ground- nuts, with shell	Soy- beans	Pulses, total	Staple Yield Index*
AGRA Total	% Growth	Production	87%	163%	93%	-24%	17%	55%	42%	42%	17%	58%	80%	18%
		Yield	29%	41%	51%	-21%	3%	27%	-6%	-7%	-23%	18%	51%	
		Area	45%	87%	28%	-5%	13%	22%	51%	51%	52%	35%	19%	
	Area (ha) 2016-18 avg	23,713,981	7,610,751	2,093,972	14,131,237	17,223,546	69,127,338	11,087,570	24,348,037	7,465,312	1,358,705	19,621,922		
	% of total cropland	16.7%	5.4%	1.5%	10.0%	12.1%	48.7%	7.8%	17.1%	5.3%	1.0%	13.8%		
Burkina Faso	% Growth	Production	125%	209%	-	-12%	11%	33%	-7%	0%	74%	410%	50%	-10%
		Yield	0%	-12%	-	-14%	-13%	-1%	-44%	-9%	6%	-7%	2%	
		Area	128%	246%	-	2%	27%	34%	67%	7%	64%	441%	48%	
	Area (ha) 2016-18 avg	962,432	168,467	0	1,267,950	1,769,671	4,183,169	3,642	16,653	513,579	23,790	1,303,745		
% of total cropland	15.8%	2.8%	0.0%	20.8%	29.0%	68.6%	0.1%	0.3%	8.4%	0.4%	21.4%			
Ethiopia	% Growth	Production	115%	1,119%	126%	150%	157%	116%	-	67%	395%	4,999%	121%	73%
		Yield	71%	62%	74%	83%	86%	81%	-	7%	70%	557%	83%	
		Area	24%	653%	30%	38%	39%	19%	-	56%	190%	840%	20%	
	Area (ha) 2016-18 avg	2,181,662	48,112	1,720,835	478,592	1,850,154	10,364,300	0	1,351,409	79,897	38,443	1,593,952		
% of total cropland	12.4%	0.3%	9.8%	2.7%	10.5%	59.1%	0.0%	7.7%	0.5%	0.2%	9.1%			
Ghana	% Growth	Production	70%	180%	-	3%	-14%	67%	97%	84%	2%	-	137%	39%
		Yield	26%	31%	-	14%	8%	36%	56%	54%	30%	-	70%	
		Area	35%	113%	-	-10%	-21%	23%	26%	20%	-22%	-	40%	
	Area (ha) 2016-18 avg	1,022,465	258,284	0	169,533	243,670	1,691,775	979,076	1,722,596	356,227	93,016	536,125		
% of total cropland	13.8%	3.5%	0.0%	2.3%	3.3%	22.9%	13.2%	23.3%	4.8%	1.3%	7.2%			
Kenya	% Growth	Production	26%	66%	-34%	5%	33%	16%	60%	-5%	-14%	2%	108%	-7%
		Yield	-4%	0%	-16%	22%	-13%	-8%	34%	-28%	69%	9%	54%	
		Area	31%	63%	-20%	-15%	49%	26%	21%	29%	-49%	-6%	36%	
	Area (ha) 2016-18 avg	2,190,596	28,394	123,999	97,391	203,863	2,667,246	66,174	315,633	8,020	2,295	1,800,168		
% of total cropland	34.6%	0.4%	2.0%	1.5%	3.2%	42.1%	1.0%	5.0%	0.1%	0.0%	28.4%			
Malawi	% Growth	Production	57%	74%	-58%	42%	104%	58%	103%	108%	102%	259%	127%	50%
		Yield	51%	38%	26%	6%	33%	47%	38%	56%	23%	49%	78%	
		Area	6%	27%	-67%	34%	53%	9%	47%	46%	64%	138%	27%	
	Area (ha) 2016-18 avg	1,694,930	60,843	639	53,766	103,005	1,913,183	232,678	483,482	388,206	172,409	732,162		
% of total cropland	44.6%	1.6%	0.0%	1.4%	2.7%	50.3%	6.1%	12.7%	10.2%	4.5%	19.3%			
Mali	% Growth	Production	414%	221%	391%	67%	106%	181%	84%	281%	40%	297%	233%	19%
		Yield	63%	59%	52%	9%	1%	60%	-7%	0%	0%	-69%	211%	
		Area	213%	101%	224%	53%	101%	75%	95%	290%	41%	1,153%	7%	
	Area (ha) 2016-18 avg	1,131,103	857,345	9,413	2,118,044	1,497,550	5,659,208	6,454	64,561	382,424	16,400	323,645		
% of total cropland	17.2%	13.1%	0.1%	32.3%	22.8%	86.3%	0.1%	1.0%	5.8%	0.2%	4.9%			

APPENDIX 2

			Maize	Rice, paddy	Wheat	Millet	Sorghum	Cereals, total	Cassava	Roots and Tubers, total	Ground- nuts, with shell	Soy- beans	Pulses, total	Staple Yield Index*
Mozambique	% Growth	Production	42%	39%	173%	-20%	-41%	24%	58%	54%	5%	-	4%	30%
		Yield	27%	-32%	-1%	-9%	-13%	19%	44%	43%	-12%	-	45%	
		Area	9%	107%	177%	-16%	-33%	4%	9%	6%	16%	-	-28%	
	Area (ha) 2016-18 avg	1,761,605	184,091	15,704	33,470	198,640	2,117,972	1,097,921	1,180,922	402,608	0	739,848		
	% of total cropland	29.6%	3.1%	0.3%	0.6%	3.3%	35.6%	18.5%	19.8%	6.8%	0.0%	12.4%		
Niger	% Growth	Production	341%	47%	-26%	50%	137%	71%	130%	179%	248%	-	274%	36%
		Yield	53%	14%	66%	26%	55%	32%	46%	64%	29%	-	141%	
		Area	234%	30%	-52%	20%	53%	30%	57%	69%	170%	-	58%	
	Area (ha) 2016-18 avg	26,101	25,756	2,634	7,087,585	3,773,913	10,930,573	12,001	22,427	870,804	0	5,564,534		
	% of total cropland	0.1%	0.1%	0.0%	39.8%	21.2%	61.3%	0.1%	0.1%	4.9%	0.0%	31.2%		
Nigeria	% Growth	Production	72%	156%	-4%	-75%	-23%	10%	42%	36%	-16%	24%	7%	-8%
		Yield	7%	40%	-17%	-49%	-10%	5%	-20%	-23%	-34%	4%	30%	
		Area	64%	83%	18%	-52%	-14%	5%	78%	79%	29%	19%	-17%	
	Area (ha) 2016-18 avg	5,998,071	4,622,087	71,276	2,278,457	6,198,736	19,352,657	6,598,593	15,299,257	2,803,902	724,167	3,551,798		
	% of total cropland	14.8%	11.4%	0.2%	5.6%	15.3%	47.8%	16.3%	37.8%	6.9%	1.8%	8.8%		
Rwanda	% Growth	Production	305%	98%	-46%	28%	-18%	82%	30%	3%	76%	1%	89%	24%
		Yield	66%	-19%	46%	-45%	0%	27%	55%	6%	-24%	-19%	23%	
		Area	146%	147%	-60%	132%	-17%	43%	-16%	-3%	129%	26%	54%	
	Area (ha) 2016-18 avg	276,948	33,073	9,112	11,624	150,566	481,322	103,763	425,154	39,011	50,956	558,698		
	% of total cropland	19.8%	2.4%	0.7%	0.8%	10.7%	34.3%	7.4%	30.3%	2.8%	3.6%	39.9%		
Tanzania	% Growth	Production	59%	159%	9%	35%	13%	71%	-4%	44%	153%	104%	114%	22%
		Yield	15%	40%	-56%	28%	4%	23%	-2%	18%	11%	25%	41%	
		Area	38%	85%	146%	5%	9%	39%	-2%	22%	123%	70%	52%	
	Area (ha) 2016-18 avg	4,084,119	1,201,393	101,008	334,579	782,779	6,559,010	930,054	1,903,498	937,448	5,626	2,110,837		
	% of total cropland	26.1%	7.7%	0.6%	2.1%	5.0%	41.9%	5.9%	12.2%	6.0%	0.0%	13.5%		
Uganda	% Growth	Production	142%	79%	47%	-67%	-28%	51%	-50%	-47%	-1%	-82%	71%	0%
		Yield	64%	93%	-9%	-12%	-50%	31%	-75%	-39%	-48%	-43%	134%	
		Area	48%	-7%	62%	-63%	44%	15%	124%	-13%	91%	-68%	-27%	
	Area (ha) 2016-18 avg	1,158,047	95,586	15,156	155,405	426,232	1,850,426	877,664	1,321,753	430,792	46,569	742,063		
	% of total cropland	12.7%	1.1%	0.2%	1.7%	4.7%	20.3%	9.6%	14.5%	4.7%	0.5%	8.2%		
Zambia	% Growth	Production	153%	143%	49%	-19%	-31%	137%	2%	13%	134%	437%	38%	20%
		Yield	27%	8%	7%	-3%	-11%	28%	0%	-4%	-9%	18%	4%	
		Area	99%	120%	38%	-17%	-25%	84%	2%	18%	159%	381%	33%	
	Area (ha) 2016-18 avg	1,225,901	27,320	24,195	44,840	24,767	1,356,497	179,550	240,690	252,395	185,034	64,346		
	% of total cropland	32.0%	0.7%	0.6%	1.2%	0.6%	35.4%	4.7%	6.3%	6.6%	4.8%	1.7%		

Source: FAOSTAT crops data, <http://www.fao.org/faostat/en/#data/QC>, updated February 2020. Units: production in MT; yield in MT/ha; area in ha; "-" indicates no data

Notes: % changes are between 2004-06 3yr average and 2016-18 3yr average; author's calculation. 3-year averages used to account for yearly fluctuation in conditions.

*Staple Crop Productivity Index is sum of yield increases weighted by relative areas for maize, millet, sorghum, and roots/tubers. Exception: AGRA total, Ethiopia, Nigeria, and Tanzania is weighted sum of total cereals plus roots/tubers.