



Africa's Land Use Problem: Is Green Revolution Agriculture a Solution or a Cause?

By Timothy A. Wise



By all accounts, food and agriculture were [barely on the agenda](#) at this month's UN Climate Summit in Glasgow, Scotland. They should have been. Food production, distribution, consumption, and waste contribute an estimated one-third of greenhouse gas emissions. In production, the majority comes from unsustainable livestock production with another large share coming from unsustainable production and use of synthetic fertilizers. But a significant share also comes from "land use change", a neutral term for the destructive expansion of agriculture onto new land.

That sort of "extensification" of agriculture can have serious environmental consequences - deforestation, soil erosion, unsustainable water use, etc. Those in turn have important implications for climate change, as a recent [UN report](#) highlighted. Land use changes due to agricultural expansion increase carbon emissions from land clearing, eliminate carbon dioxide-absorbing plants such as rainforests, and create greenhouse gases with incoming modern farming methods. According to the UN, they account for about 30 per cent of agriculture-related emissions.

The simplifying neo-Malthusian perspective attributes extensification to growing populations exerting pressure on scarce natural resources. Increasing farmers' productivity on existing lands in regions such as Africa where yields are relatively low is the mainstream solution. The goal is to foster "sustainable intensification" - growing more food on the same land. With commercial inputs

such as commercial seeds and synthetic fertilizers, farmers can intensify their exploitation of existing agricultural land, raising productivity and easing pressures from growing populations to bring new lands into cultivation.

The [Alliance for a Green Revolution in Africa](#) (AGRA) was founded 15 years ago to address the productivity problem. With generous funding from the Bill and Melinda Gates and Rockefeller foundations, the alliance set out to reduce chronic hunger and poverty by increasing yields in key food crops through the expanded use of commercial seeds and fertilizers. This is the “technology package” credited with raising agricultural productivity in what came to be known as the first [Green Revolution](#) in India and other parts of Asia and Latin America in the 1970s.

Africa’s Green Revolution has largely failed to promote either sustainability or intensification. Evidence suggests that the initiatives, which include high levels of government subsidies for farmers to use Green Revolution inputs, are both failing to raise productivity and contributing to the unsustainable expansion of farming onto new lands.

My research shows that excessive incentives to maize and a few commercial crops have persuaded farmers to shift land out of other nutritious crops while expanding production onto new lands. The result is higher maize production but without significant productivity increases. Meanwhile, we see rising levels of malnourishment and undernourishment as poor farmers fail to benefit from rising productivity but see their families’ diet diversity decline as the diversity of food crops in their fields declines.

Climate change and the unaddressed pandemic emergency are contributing to a deep hunger crisis in Africa. The worst dangers of famine are in areas of conflict such as Ethiopia, but hunger is more widespread. The [United Nations has recorded](#) a 50 per cent increase in the number of severely undernourished people in Sub-Saharan Africa since 2006. Underlying that deprivation is a model of agricultural development that is encouraging unsustainable land use and undermining crop and diet diversity.

These alarming outcomes have prompted [African food producing organizations](#) to call on donors to end their support for AGRA and other Green Revolution programmes. They call for a shift to agroecological initiatives that have been shown to generate sustainable productivity improvements across a range of food crops, addressing the need for more food and more nutritious diets while easing pressures on unsustainable land use.

Redoubling climate damage

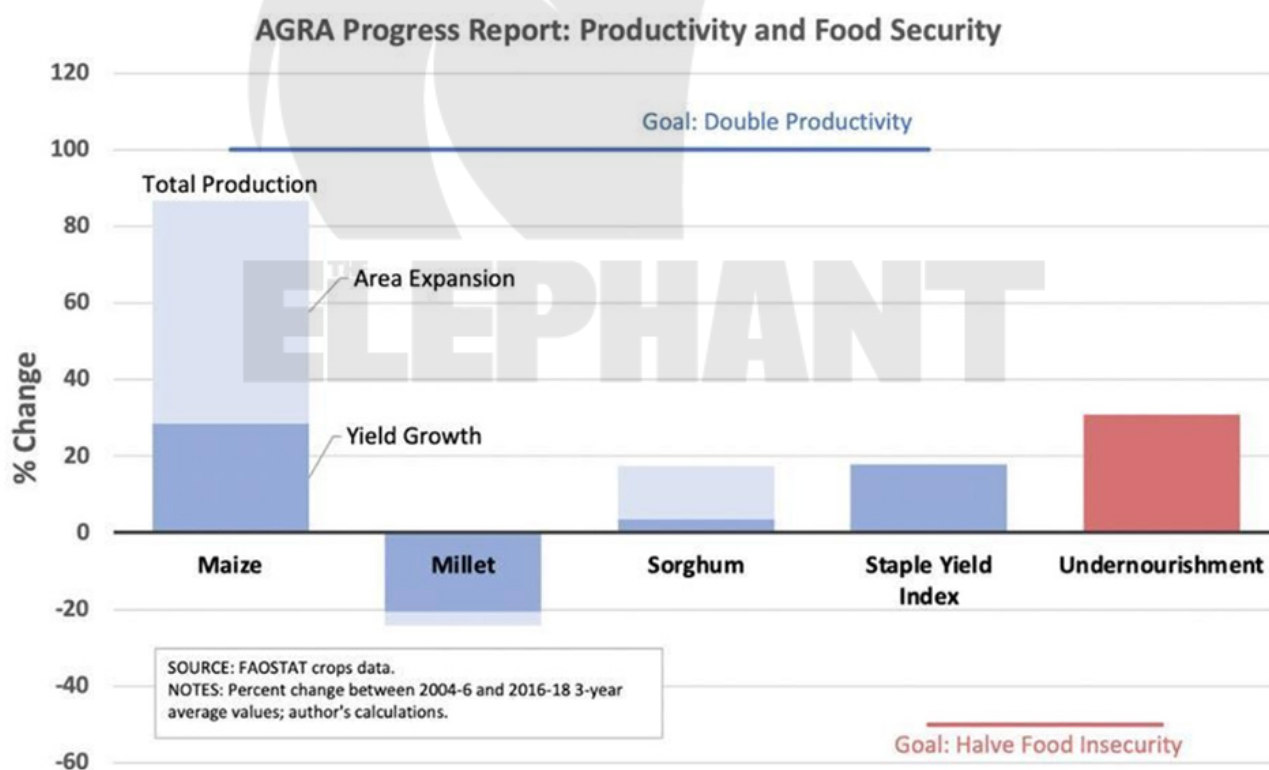
Neither evidence nor entreaties have persuaded Green Revolution leaders that their strategies may be misguided. In October, Mr Hailemariam Desalegn, former Prime Minister of Ethiopia and current Chair of the Board of AGRA, acknowledged the problem. “Over the last two decades, the African continent has registered the most rapid rate of agricultural production growth of any region of the world,” he wrote in an [opinion column for African Arguments](#). “Unfortunately, most of this growth has been through the expansion of agricultural land, not an increase in productivity. With our population expected to double by the middle of the century, our farmers need to continue growing more, while using fewer resources.” He went on to argue that the intensive use of Green Revolution seeds and fertilizers could achieve that. He has urged governments and donors to redouble Green Revolution efforts.

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The evidence suggests otherwise. In 2020, I carried out [a comprehensive assessment](#) of the impacts of Green Revolution programmes in AGRA's 13 focus countries. AGRA refused to share its own impact data, so I used national-level data on crop production, productivity, and area expansion to determine whether AGRA was meeting its stated goal of doubling productivity for 30 million small-scale farming households by 2020. Because 30 million represent the vast majority of farms in AGRA's programme area, national-level data from 2006-2018 would reveal whether such a productivity revolution was occurring. I also assessed progress toward AGRA's stated goals of doubling incomes for those same farmers and cutting food insecurity by half by 2020.

I found the Green Revolution was failing on its own terms. Productivity growth was slow, even for heavily supported and subsidized crops such as maize. More traditional staple crops such as millet and sorghum showed stagnation or decline. My estimate of productivity increases for a basket of staple crops in AGRA's 13 focus countries showed just 18 per cent yield growth over 12 years, a rate barely higher than the preceding 12 years. Not surprisingly, poverty remained endemic, particularly in rural areas. And rather than cutting food insecurity by half, the number of undernourished people increased 31 per cent in those 13 countries.

The data also revealed that Green Revolution initiatives were not only failing to achieve sustainable intensification, they were promoting the opposite. As the graph shows, between 2006 and 2018 maize productivity rose by only 29 per cent while the area planted to maize increased by 45 per cent in AGRA's 13 focus countries. Overall, production increased 87 per cent, but mainly because of extensification rather than intensification. Meanwhile, land planted to other staples such as millet and sorghum declined or stagnated, as did yields. My composite staple yield index showed just 18 per cent yield growth. (All data cited here, unless otherwise indicated, are from the United Nations, cited in my [Tufts University Working Paper](#).)



This outcome will come as no surprise to those living in AGRA countries where incentives are heavily concentrated on maize. In most AGRA countries, governments provide large subsidies to farmers to buy and use commercial maize seeds and fertilizers. AGRA itself has spent one billion dollars in its 14-years of work, but African governments have been spending up to one billion dollars *per year* on such Farm Input Subsidy Programmes (FISPs). Some governments also pay above-market prices to

farmers for their maize to maintain public grain reserves.

As any agricultural economist can attest, land and investments flow to crops that are subsidized or otherwise supported. That has been true in the United States for decades. Farmers make complex calculations to gauge the relative returns to corn, soybeans, wheat, and other crops based on market conditions and relative levels of government support.

In Africa, maize has received the lion's share of the support in most AGRA countries, so land and investment have moved more heavily into maize production. Farmers are incentivized to switch out of existing crops like millet, which has seen an alarming 24 per cent decline in production and a 21 per cent drop in yields, and into maize. Hence the decline in crop diversity under Green Revolution programmes. Farmers with access to land are also incentivized to bring new land into production, which allows them to reap the benefits of government support programmes. Hence the extensification of production.

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Across AGRA countries, there was a 13 per cent increase in land under cultivation from 2006 to 2018, the majority of it in AGRA's two principal supported crops, maize and rice. More than 7 million more hectares of land were planted in maize in 2018 than in 2006. Another 3 million more hectares were planted in rice. Those 10 million hectares accounted for nearly all of the expansion in land planted to cereal crops in that time period.

It is hard to argue that Green Revolution programmes did not contribute significantly to this problem of agricultural extensification. That is especially problematic when such input-intensive agriculture is failing to generate the promised productivity gains or reductions in hunger.

Studies in extensification: Zambia and Rwanda

Zambia and Rwanda have both expanded maize production dramatically, but both illustrate the ways in which Green Revolution incentives have led to undesirable outcomes. Zambia was one of AGRA's focus countries until a few years ago. It left the alliance but has re-joined recently. Zambia provides extensive subsidies for maize production and also buys maize at supported prices for its food reserve programme. As a result, it has the highest levels of fertilizer use among AGRA countries. Between 2006 and 2018, Zambia increased maize production by 150 per cent, making it an apparent Green Revolution success story.

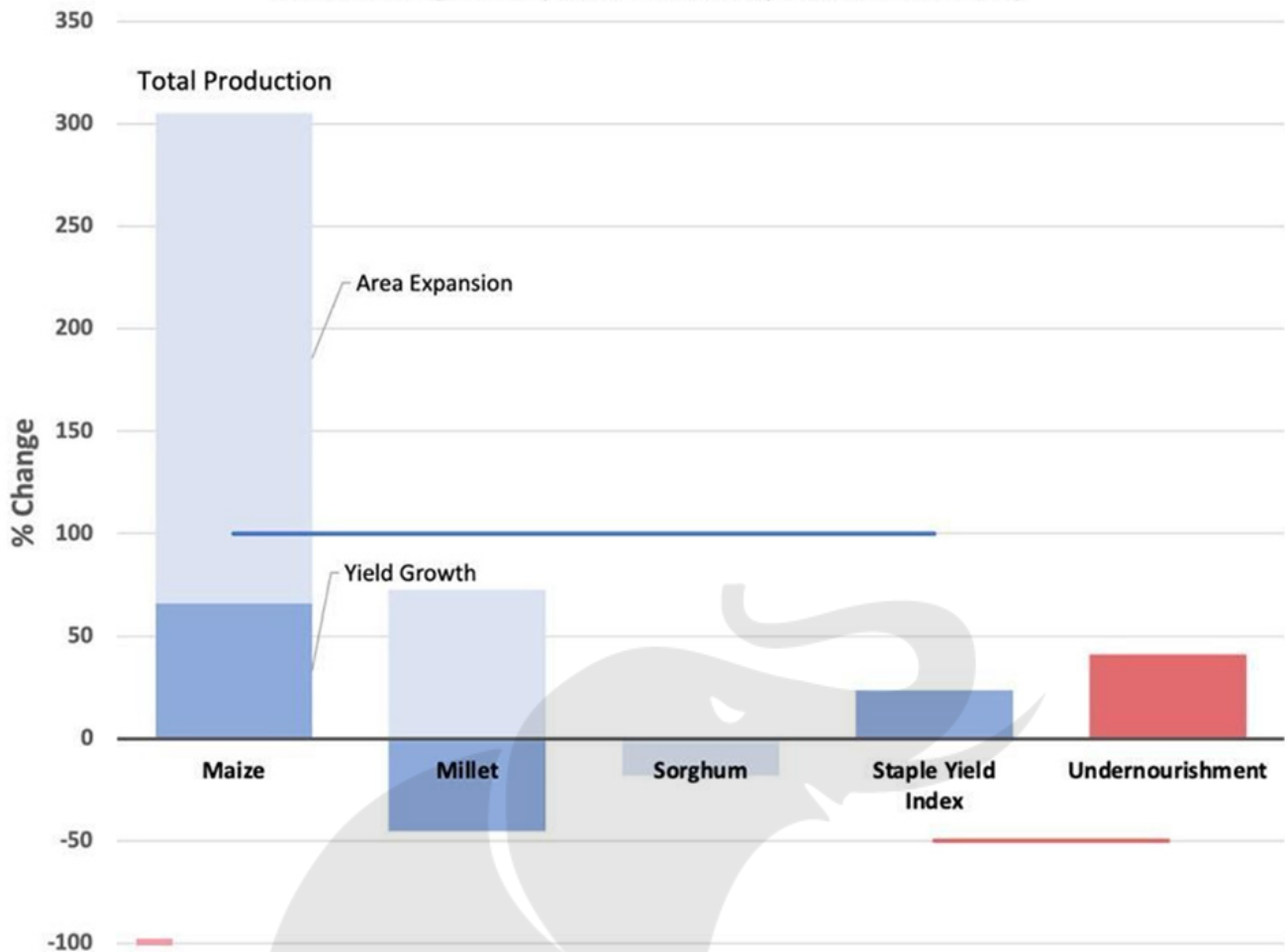
Zambia Progress Report: Productivity and Food Security



But, as the graph shows, only a small share of the added maize came from productivity growth. Yields grew just 27 per cent while the area planted to maize doubled. Millet and sorghum production and yields declined and farmers moved land out of those traditional staples into maize in response to Green Revolution incentives. Two-thirds of Zambia's 32 per cent increase in land planted to crops was attributable to new land planted to maize. Staple yields overall increased just 20 per cent in that 12-year period. And all that maize failed to stem hunger or reduce poverty. The number of undernourished Zambians increased 29 per cent while extreme rural poverty remained at 78 per cent.

Rwanda has been a poster child for AGRA for years. AGRA's current president, Agnes Kalibata, ascended to that position in large part due to her success in increasing maize production as Rwanda's Minister of Agriculture. Between 2006 and 2018, maize production increased 300 per cent thanks to a well-funded and [heavy-handed Green Revolution initiative](#). Seeds and fertilizer were heavily subsidized and farmers were fined if they did not agree to use the inputs.

Rwanda Progress Report: Productivity and Food Security



As the graph shows, Rwanda achieved higher maize yield growth than Zambia, increasing productivity by 66 per cent. But as in Zambia, most of the added maize came from a 146 per cent increase in new land planted to the crop, not from productivity. Similarly, rice production doubled, but yields actually declined 19 per cent, with land planted to rice increasing 147 per cent. 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 per cent, while sorghum land declined 17 per cent.

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My more comprehensive Staple Yield Index captures Rwanda's poor performance across all staple crops. Compared to the much-touted 66 per cent increase in maize yields, we see just a 24 per cent increase in yields for key staples - maize, millet, sorghum, roots and tubers. Since 2006, extreme poverty remained high, falling just three percentage points to a still alarming 60 per cent. As in Zambia, all that extra maize did not help the hungry; the number of undernourished Rwandans has increased 40 per cent since 2006.

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. Rwanda does not have a great deal of uncultivated arable land,

so most of the area expansion for maize and rice came from other crops rather than new lands. Still, Rwanda highlights how heavy incentives for Green Revolution crops create outcomes at odds with the goals of sustainable intensification for food security.

“Time to change course”

AGRA Board Chair Hailemariam Desalegn is correct to identify the problem of unsustainable expansion onto new lands in Africa, but he is wrong to think that his Green Revolution will solve that problem. Evidence shows that Green Revolution programmes are among the principal causes of unsustainable land use. Incentives for a narrow range of supported crops entice farmers and investors to open new lands for cultivation. Meanwhile, those commercial inputs are failing to generate any sort of productivity revolution or address the alarming 50 per cent rise in the number of undernourished Africans since AGRA was founded in 2006.

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As representatives from the Alliance for Food Sovereignty in Africa state in [their published response to Mr Desalegn](#), it is “time to change course: the future is in agroecology.”

It is a myth that the only way to increase productivity on existing agricultural lands is through Green Revolution seeds and fertilizers. Examples abound across Africa of farming communities that are increasing both the diversity and productivity of their fields. In Africa and other developing countries, some [15 million small-scale farmers](#) interplant so-called green-manure cover crops alongside their food crops to fix nitrogen in the soil, reduce weeding, add another food or forage crop to their fields, and increase the carbon sequestered in the soil. Scientists recommend appropriate cultivars from a range of more than 100 proven cover crops.

The Lablab bean native to East Africa, for example, has been shown to fix very high levels of nitrogen in the soil through its roots, improving soil fertility and water retention. The added nitrogen can raise maize yields threefold in those same fields, eliminating the need for inorganic fertilizer. And farm families get another nutritious food crop from their fields.

Such approaches are documented in a new [UN report from its High Level Panel of Experts](#). Farmers are getting far better results, growing more food on existing land in sustainable ways that increase soil fertility over time. One [University of Essex study](#) surveyed nearly 300 large ecological agriculture projects across more than 50 poor countries and documented an average 79 per cent increase in productivity with decreasing costs and rising incomes. This is far higher than AGRA’s 18 per cent yield growth in staple crops.

Agroecological farming can also achieve sustainable extensification. With the support of some governments, West African farmers are expanding onto uncultivated lands but in a way that builds rather than compromises the environment. In long-term land rehabilitation projects in the drylands of West Africa, farmers in Burkina Faso, Senegal, Ghana, and Niger are leading [“another kind of green revolution.”](#) They regenerate tree growth on deforested lands then diversify production as part of [agro-forestry initiatives](#) that are increasingly supported by national governments. This restores soil fertility, increases water retention, and has been shown to increase yields 40 to 100 per cent within five years while increasing farmer incomes and food security. According to one study, farmers rehabilitated at least 200,000 hectares of degraded land in Burkina Faso, enabling farmers to grow cereals on land that had been barren.

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Land reclamation is a desirable form of extensification, avoiding the negative environmental impacts of the input-intensive farming of monocultures of Green Revolution crops. Similarly, agroecology programmes intensify the production of diverse food crops on existing lands in ways that rebuild soil fertility and resilience to climate change.

Such strategies stand in stark contrast to Green Revolution programmes that are failing to help solve Africa's unsustainable land-use issues. In fact, they are making them worse.

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