

# En route to plentiful food production in Africa

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Africa south of the Sahara is going through a major agricultural transformation. Low crop productivity, hunger and pessimism are being replaced by a rapid rise in food production, an increasingly vibrant agricultural value chain and convergence towards a common goal.

There are many reasons to be pessimistic about the prospects of plentiful food production in sub-Saharan Africa. Between 1961, when records began, and 2005 average cereal grain yields in the region hovered below one metric tonne per hectare ( $\text{t ha}^{-1}$ ), rendering the average smallholder farming household food and nutrient insecure<sup>1,2</sup>. The same period saw grain yields rise to  $3 \text{ t ha}^{-1}$  in South Asia, Southeast Asia and Latin America,  $5 \text{ t ha}^{-1}$  in China, and  $10 \text{ t ha}^{-1}$  in North America, Europe and Japan<sup>1</sup> (Fig. 1). Sub-Saharan Africa failed to benefit from the improved crop varieties that saw food supplies grow so significantly in Asia and Latin America because the main biophysical constraint on crop production — the depletion of soil fertility on smallholder farms — was not addressed<sup>3</sup>.

Set against this backdrop of stagnating yields, the current African population of almost one billion is set to double by 2050<sup>4</sup>. In addition, much of the continent suffers from high levels of malnutrition, inequality, corruption, poor infrastructure, political upheaval and high vulnerability to climate change. It therefore comes as no surprise that sub-Saharan Africa is the one region in the world where per capita food production is falling<sup>1</sup>.

Over the past decade, however, Africa has seen major political, economic and social changes. There are now 23 democracies; foreign direct investment grew from US\$15 billion in 2002 to US\$46 billion in 2012, an important signal that Africa is ready for business; and since 2000 high-school enrolment has risen by 48%, life expectancy by 10 years, real income per person by 30%, and deaths by malaria have fallen by 30% (ref. 5). Hand-in-hand with these changes, Africa has seen crop yields rise significantly in many food-insecure parts of the continent, underpinned by the collective efforts of governments, donor agencies, the private sector, non-governmental

organizations, scientists and farmers. Provided that interventions put in place over the past decade are sustained, I argue that better yields can be achieved by smallholder farmers continent-wide.

## The seeds of change

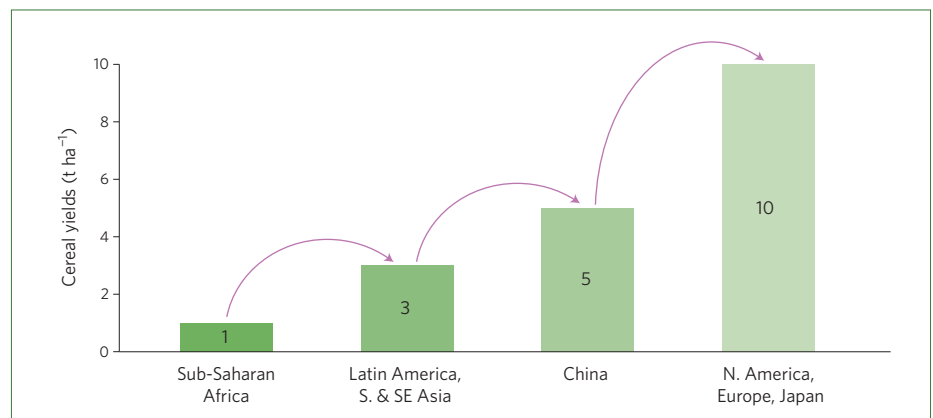
In 2004 the then UN secretary general Kofi Annan called for a uniquely African green revolution focused on the improvement of agricultural productivity through the replenishment of soil fertility, together with the use of improved seeds, and the promotion of human nutrition, market access, environmentally sustainable practices and enabling policies<sup>6</sup>. Malawi, a country plagued by famine, was the first to respond. By subsidizing most of the cost of hybrid seeds and mineral fertilizers, Malawi increased yields of the country's staple crop, maize, by 2.6 times between 2005 and 2007<sup>7</sup>. In spite of criticisms by donor agencies and academics<sup>8</sup>, the seed and fertilizer subsidies provided food security to millions of Malawians. New initiatives aimed at

raising yields in other parts of the continent followed in 2006, such as the creation of the Alliance for a Green Revolution in Africa and the Millennium Villages Project<sup>9,10</sup>. More recently the private sector joined the effort, marking the beginnings of a private-sector-led, government-enabled African Green Revolution<sup>11</sup>.

The results of these efforts are starting to materialize. Cereal grain yields increased by 50% between 2005 and 2013, still a miserable  $1.5 \text{ t ha}^{-1}$ , but the trend is up for the first time since records began<sup>1</sup>. And out of the 49 countries in sub-Saharan Africa, 17 have already achieved the Hunger Millennium Development Goal of halving the number of people who suffer from undernutrition by 2015, including the two most populous nations, Nigeria and Ethiopia, although cereal yields are still less than  $3 \text{ t ha}^{-1}$  (ref. 12).

## The interventions

Despite the clear progress made in the last decade, 21 countries are not on target



**Figure 1** | Average cereal grain yields in 2005. Sub-Saharan Africa can move from  $1$  to  $3 \text{ t ha}^{-1}$  by increasing access to improved seeds and fertilizers. Going from  $3$  to  $5 \text{ t ha}^{-1}$  will require interventions across the agricultural value chain. Achieving  $10 \text{ t ha}^{-1}$  is agronomically possible, but beyond the scope of current interventions.

to achieve the Millennium Development Goal<sup>12</sup>. Lagging behind are those counties affected by conflict or poor governance, and those that have not allocated the agreed 10% of their national budget to agriculture. However, interventions put in place over the last decade, which span the whole of the agricultural value chain, could see food supplies grow throughout sub-Saharan Africa.

**Inputs and financing.** The inability to access high-quality seeds, fertilizers and other necessary inputs has kept many African farmers stuck at the 1 t ha<sup>-1</sup> yield level. But this barrier is in the process of being overcome. There are now 85 African-owned seed companies and several global companies focused on the improvement of regional crop varieties, a very good start<sup>13</sup>. Fertilizer consumption is increasing thanks to subsidies and credit, but also to fertilizer manufacturers working with governments (as in Tanzania and Mozambique) to upgrade port facilities and so reduce the transportation costs that can double the price of fertilizer from port to inland locations<sup>13</sup>. The rise of 'agrodealers' — trained shop operators selling improved seeds, fertilizers and other inputs in remote villages — has placed these inputs within the reach of thousands of farmers; tens of thousands of such dealerships can be found in rural areas nowadays, although many more are needed<sup>14</sup>.

Financing was tackled initially by subsidies that target smallholder farmers. More recently, African governments and donor agencies have teamed up to provide US\$3.5 billion to local banks in Kenya, Nigeria and other countries to cover the cost of a proportion of potential loan defaults by smallholder farmers, and thereby encourage lending<sup>14</sup>. And 14 million farmers in Nigeria now use mobile phones to access credit and subsidies, buy agricultural inputs and pay back loans<sup>14</sup>.

**Production.** Poor agronomic practices have prevented farmers from getting the most out of their seeds, fertilizers and soils. However, public and private extension workers are starting to deliver up-to-date advice on all aspects of crop and soil management<sup>15</sup>. These practices are designed to boost yields and to ensure the long-term sustainability of the system. Integrated approaches to pest management, for instance, offer an affordable and environmentally friendly solution to dealing with infestations<sup>16</sup>; particularly useful when yields rise to the 3 to 5 t ha<sup>-1</sup> mark. Mobile phones can be used to further facilitate the flow of information to smallholder farmers, but this is still work in progress<sup>17</sup>.

**Processing and storage.** 30 to 40% of produce is lost pre- and post-harvest across much of the continent<sup>18</sup>. Fungal infestations, due to a lack of dry storage facilities, and insect and rodent infestations account for much of the losses. The private sector, with the support of governments, is improving processing and storage facilities at the village and town level. The concomitant, private-sector-led improvement in roads, ports and internet infrastructure in many regions will contribute to the dissemination of these facilities<sup>11</sup> together with information on good post-harvest practices.

**Markets and institutions.** African farmers are often unable to sell surplus grain following bumper harvests, despite sky high demands for the produce in neighbouring regions. Part of the problem stems from an inadequate flow of information on market conditions. But farmers are now able to access information on the price their produce will sell for in different locations via mobile phones, a major breakthrough. In addition, farmer associations are starting to bulk their harvests and establish delivery schedules to local supermarkets. And contract farming arrangements with the private sector are growing in number, leading to the export of products such as green beans and groundnuts. Together, the collective actions of farmers, agrodealers, cooperatives and policy makers are beginning to turn around the old arrangement of exporting raw commodities and buying them back as finished products. Perhaps Kofi Annan's vision of an Africa that adds value to raw commodities such as fruits, cassava, cacao, cow hides and cotton, and exports instead fruit juices, starch, chocolates, leather shoes and clothes may not be too far in the future.

### Working towards five tons per hectare

One way to visualize the way forward is in terms of continent-wide cereal crop yields (Fig. 1), a rough indicator of the state of economic development and a necessary but not sufficient condition for food security. The first stage — well underway — is to go from the sub-subsistence level of 1 t ha<sup>-1</sup> to the 3 t ha<sup>-1</sup> seen in Latin America, South and Southeast Asia around the year 2000<sup>1</sup>. In many cases this can be achieved with the best seeds available, and blanket fertilizer applications. Although inefficient, this simple approach gives farmers the opportunity to take the first step out of poverty. When farmers move from 1 to 3 t ha<sup>-1</sup> they often begin to diversify their operations to include dairy and poultry farming, and the production of grain legumes and vegetables. This diversification provides smallholder farmer households

with the additional protein, vitamins and minerals needed for a healthy diet<sup>10</sup>.

To go from 3 to 5 t ha<sup>-1</sup>, the level of productivity seen in China, will require changes to production, processing and markets, which in turn will hinge on technology and a certain degree of IT literacy; there are millions of young, educated Africans who would no doubt relish the opportunity to apply their knowledge in such a way. In addition, institutions will need to be strengthened and market access enhanced, so that farmers can sell their produce globally. This transformation will require significant investment, and the change will not happen overnight — it took China 20 years to go from 3 to 5 t ha<sup>-1</sup> (ref. 1) — but it could certainly happen in Africa by 2050. To go from 5 to 10 t ha<sup>-1</sup> is technically possible, as shown in the Millennium Villages and other parts of the continent. But it is too early to think about this step, except for realizing that it is agronomically feasible.

Enormous challenges remain to achieving even 3 t ha<sup>-1</sup>. Poor governance and conflicts continue, and the negative effects of climate change could force yields down if improved crop cultivars adapted to the altered conditions do not materialize. But the transformation is underway. Fuelled by the converging efforts of governments, donor agencies, the private sector, non-governmental organizations, scientists and farmers, sub-Saharan Africa could become one of the world's breadbaskets by 2050<sup>19</sup>. □

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