

COMMENT

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Feeding future populations means doubling the productivity of neglected but nutritious crops such as yams and green bananas.

Freeze the footprint of food

Jason Clay identifies eight steps that, taken together, could enable farming to feed 10 billion people and keep Earth habitable.

The single largest human impact on our finite planet comes from producing food. By 2050, there will be 2 billion to 3 billion more people on Earth with three times more per capita income, consuming twice as much as now. About 70% will live in cities — more than are alive today. By 2050, we may need three Earths to meet the demands of our consumption. We urgently need to find ways to do more with less.

In the past 18 months, members of non-governmental organizations (NGOs), academia and the private sector have come

together to develop ways to reform the global food system by increasing food production without damaging biodiversity. Groups such as the Global Harvest Initiative (www.globalharvestinitiative.org) and the Sustainable Agriculture Initiative (www.saiplatform.org) are working to freeze the footprint of food.

It is a daunting challenge. An estimated 70% of the land that is suitable for growing food is already in use or under some form of protection. For 50 years, farmland has grown at 0.4% a year, at the cost of natural habitat.

In the past decade, as developing economies have grown, this has increased to 0.6% and, with it, more biodiversity has been lost.

Historically, technology has helped to stem this expansion of the agriculture frontier. During the 'green revolution' of the 1960s and '70s, productivity increased at a faster rate than population and consumption, and encroachment was slowed or even halted in many places. Now, technology lags behind rising population and consumption. It needs to catch up, fast.

We will all feel the consequences of an ▶

► unhealthy planet, but developing regions will bear the heaviest burden. Nowhere are these realities more pressing than in Africa. The effect of rising food prices has sparked political strife in Tunisia, Algeria and Egypt. Africa is a continent with many complicating factors, and solutions to feeding the planet should be applied there first.

Freezing the footprint of food will require many actors working on several strategies simultaneously. There is no silver bullet. My experiences working with farmers in Latin America, Asia and Africa, and my current role as senior vice-president of market transformation at conservation group WWF, has shown me that we can find common ground with producers big and small to reduce the impact of key commodities.

I have identified eight strategies that, if applied globally and simultaneously, will help to reform the food system and protect the planet. Work has started on each of these 'food wedges', but no group is tackling them all at once. For example, WWF and its partners are directly supporting action on genetics, waste and agricultural carbon. Progress on the others requires more ideas and help, especially in Africa where the challenge is the starkest. Here are some of the goals — and research gaps — as they apply to Africa.

EIGHT FOOD WEDGES

Genetics. Ten crops account for 70–80% of all calories consumed. Only one is on track to double production by 2050. Most estimates suggest that all ten need to double to meet future demand. I'm an environmentalist and am convinced that to increase production, we can't afford to ignore genetics, as long as it is applied in a responsible way. There has been a lot of debate over genetic modification, but there is in fact huge potential in using genetics through traditional plant breeding to select traits — techniques which humans have been using for more than 6,000 years. Now we have twenty-first century technology that allows even faster selection.

In Africa, staple food crops such as yams, plantains and cassava have been relatively neglected by plant breeders. The genomes of these crops should be mapped as a first step towards solutions to doubling or even tripling productivity, and improving drought tolerance, disease resistance and overall nutrient content. Genetic mapping would allow researchers to identify specific traits and markers within a species, and eventually breed plants displaying them. There are plant breeders in Africa prepared to do this.

On 1 July, the African Union formally stated that increasing the productivity of neglected crops in Africa is a priority when it comes to increasing food production there. In June, the African Union's New Partnership for Africa's Development (NEPAD), food company Mars and WWF convened

agriculture experts at a meeting in Washington DC to identify a host of neglected crops in Africa. The group will work with a major scientific institute to sequence the genomes of these crops over the next 3–5 years and then place the information in the public domain. The long-term goal is to train and involve local plant breeders to reduce the time it takes to get acceptable planting materials to farmers.

Better practices. For every crop, the best producers globally are 100 times more productive than the worst. Even within nations, producers can be 10 times more efficient than their neighbours, whether they farm maize (corn) in Nebraska or cassava in Nigeria. We will gain most — in terms of food production, increased income and reduced environmental impacts — by improving the poorest-performing producers.

In Africa, it takes too long for better practices to be passed along within the farming community. Traditionally, farmers learn

"We will gain most by improving the poorest-performing producers."

from their parents and from other farmers. Innovation is slow in this closed loop, and governments have scant funding for educating farmers.

Through mobile phones, which many African farmers already have, we can help farmers to connect to a shared information hub, allowing one individual to serve many villagers.

Conventionally, such extension systems have been run by governments, but it is not clear if they are up to the task in Africa. Whether provided by the private sector or by government, these systems need to provide value to farmers — increased production, efficiency or net profits. New information hubs must leapfrog, or at least compliment, more traditional extension services.

Efficiency through technology. We need to double the efficiency of every agricultural input, including water, fertilizer, pesticides,

energy and infrastructure. It currently takes one litre of water to produce one calorie of food. If we halved the water used and doubled the production we would quadruple the efficiency. The technology exists to do this, and the best producers can already achieve these results.

In Africa, many technologies are two or even three generations behind those used elsewhere. Soil is a great place to start. Increasing organic matter (through root mass and mulching) can rebuild the fertility of soils, double production and halve water usage and other inputs. Measurement is also key — the distance between plants, between rows, the amount (and timing) of fertilizer applied. The biggest challenge may be that many smallholdings in Africa are simply not economical. Fortunately, some technologies are scale-neutral: mulching works even in household gardens.

Degraded land. Instead of farming in new areas, we need to rehabilitate degraded, abandoned or underperforming lands. Global goals should be 100 million hectares rehabilitated by 2030 and 250 million by 2050. This means not just halting erosion and degradation but reversing it through the construction of terraces and the planting of trees and grasses. Most farmland in Africa has been degraded over the past century by obsolete practices that were developed when population densities were lower. Ethiopia and South Africa have shown that rehabilitation can work. Each has supported efforts to halt soil erosion, and used a combination of trees, grasses and crops to build up soil organic matter.

Property rights. How many farmers will plant a tree or invest in sustainability if they don't own the land, not just for themselves but to pass on to their children? The lack of clear property rights is a significant barrier to food security in Africa, especially in female-led households, which make up the majority of smallholders. By 2020, we should



Can we halve food waste? Greater use of grain silos in Africa could help cut post-harvest losses.

G. OSODI/PANOS PICTURES



The use of farming inputs, including water and fertilizers, needs to be more efficient. This means introducing better tools and practices in places such as Mali.

D. TELEMANS/PANOS PICTURES

aim for 50% of African households to have a title to the lands they cultivate.

Changing this will not be easy, because property rights are controlled by governments. Foreign assistance for economic development should be linked to the establishment of property rights for individuals. The African Union, NEPAD or the World Bank could take the lead in encouraging nations to ensure property rights and to document positive changes on the ground.

Waste. Globally, we waste as much as 30–40% of all food produced, or one of every three calories. If we could eliminate waste, we would halve the amount of new food needed by 2050. In rich nations, most food is wasted by individual and institutional consumers.

In Africa, most food waste results from post-harvest losses and lack of infrastructure. One solution could be a one-tonne storage device that safeguards grain and other food, allowing product storage at harvest and until market prices improve. Such a device would need to be collapsible, resealable, locally repairable, and to protect food from moisture, animals, insects and mould. A monetary prize would encourage several prototypes, and a leading institution should champion it. Our goal in Africa should be to cut post-harvest waste in half by 2030.

Consumption. One billion people don't have enough food, and yet one billion people eat too much. We need to cut each of these figures in half by 2030, with the most urgent focus on those without enough to eat. About half of these people do not own land or produce their own food; they are split between rural and urban areas, but by 2050 most will live in cities.

About 40% of children under the age of five in sub-Saharan Africa are stunted from malnutrition, and as a result have reduced skills, income and lifespans. The leaves of many common crops in Africa, such as

cassava, sweet potatoes and amaranth are dense in nutrients, but are often not seen as traditional foods and thus not eaten. These leaves should be used to enrich flour in school lunch programmes and, through the education of mothers, in home cooking. The rural poor in Africa have always had access to such wild 'famine foods', but for the urban poor there is no such buffer.

Carbon. Soil carbon — or organic matter — is key to conserving farmland for future generations. Indeed, the single best measure of rehabilitated soil is increasing organic matter from less than 0.5% to 2% or more. However, half of the world's top soil, in which most soil carbon resides, has been lost in the past 150 years.

Some analysts suggest that Africa has been losing 1% of soil organic matter every year since the 1960s. This is worse than in any other region of the world, and it results in lower productivity and inefficient use of inputs such as fertilizer and water. Burning (before planting, before harvest or after harvest) decreases soil organic matter. This was an acceptable agricultural practice when land was plentiful and left fallow for many years. But, with rising populations and smaller plots of farmland, practices need to change. Scientists in Australia, for example, suggest that when sugarcane is not burned before harvest, producers save up to 1.5 million litres of irrigation and rain water per hectare, because organic matter retains soil moisture.

Two other approaches would help Africans to conserve their soils. First is a greater emphasis on tree crops and deep-rooted grasses. Trees and grasses build soil carbon and reduce erosion, increasing yields and the efficiency of inputs. Trees can be cash or subsistence crops, and can be assets in their own right (as a source of firewood).

Second, we need carbon markets for agriculture. Retailers or brand-named

companies that purchase sugar, milk, coffee, cocoa or palm oil could also buy the carbon that the farmer sequestered or avoided releasing during production. The carbon would need to be third-party verified and aggregated at a mill or trading house. The goal should be for food producers to sell 1 billion metric tonnes of carbon per year by 2030. This would make food production more sustainable, marginal lands more viable, and producers more financially secure. Over the next year, WWF, with support from the Dutch government and food-linked companies including Unilever, Nutreco and Rabobank, will begin to explore the amount of carbon that could be bundled with commodities and sold in global markets.

DOUBLE OR BUST

Progress on some food wedges will occur faster than others. But every current system of food production needs to double productivity per hectare. If we cannot double the genetic potential of the 10–15 main calorie crops, on the same amount of land, we will fail to meet rising demand. NGOs and academics do not control the global food system, so instead they must try to change how governments and the private sector think about food production.

Today, most farmers in Africa do not produce enough to feed their own families. No single strategy will solve the global food problem or even ensure sufficient food for Africa. But with the right partnerships, and with improvements across the board, we might be able to feed the world without destroying the planet. ■

Jason Clay is senior vice-president, market transformation, WWF, Washington DC 20037, USA.
e-mail: jason.clay@wwfus.org