



Filling in the Gaps

Critical Linkages in Promoting African Food Security An Atlantic Basin Perspective

*Joe Guinan, Katrin A. Kuhlmann,
Timothy D. Searchinger, Elisio Contini,
and Geraldo B. Martha, Jr.*

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Wider Atlantic Series

G | M | F The German Marshall Fund
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STRENGTHENING TRANSATLANTIC COOPERATION



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The German Marshall Fund of the United States (GMF) is a non-partisan American public policy and grantmaking institution dedicated to promoting better understanding and cooperation between North America and Europe on transatlantic and global issues. GMF does this by supporting individuals and institutions working in the transatlantic sphere, by convening leaders and members of the policy and business communities, by contributing research and analysis on transatlantic topics, and by providing exchange opportunities to foster renewed commitment to the transatlantic relationship. In addition, GMF supports a number of initiatives to strengthen democracies. Founded in 1972 through a gift from Germany as a permanent memorial to Marshall Plan assistance, GMF maintains a strong presence on both sides of the Atlantic. In addition to its headquarters in Washington, DC, GMF has seven offices in Europe: Berlin, Paris, Brussels, Belgrade, Ankara, Bucharest, and Warsaw. GMF also has smaller representations in Bratislava, Turin, and Stockholm.

About the Wider Atlantic Program

This report was prepared for GMF's Wider Atlantic program, a research and convening partnership of GMF and Morocco's OCP Foundation. The program explores the north-south and south-south dimensions of transatlantic relations, including the role of Africa and Latin America, and issues affecting the Atlantic basin as a whole.

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An Atlantic Basin Perspective

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Table of Contents

<i>Preface</i>1
<i>Executive Summary</i>3
<i>Introduction: Food Security and African Agriculture</i>7
<i>1. Africa's Development Corridors: Pathways to Food Security, Regional Economic Diversification, and Sustainable Growth</i>	23
<i>2. Synergies in the Solutions to Africa's Climate and Food Security Challenges</i>	67
<i>3. Brazil and African Agriculture: Lessons from Brazilian Experience, Prospects for Cooperation</i>	107
<i>Conclusion</i>	123
<i>Annex</i>	131
<i>About the Authors</i>	133

Preface

In July 2010, the German Marshall Fund of the United States (GMF) and Morocco's OCP Foundation launched a major multi-year partnership to explore emerging issues in the wider Atlantic space. This endeavor builds on a continuing partnership focused on geopolitical and geo-economic developments in the Mediterranean. Our starting point is the notion that the future of transatlantic relations will be shaped, to a substantial extent, by the role of emerging actors in the “southern” Atlantic, and north-south relations generally. The growing role of Brazil, West Africa, and South Africa is part of the picture. Countries like Morocco now have strong incentives to reinforce the Atlantic dimension of their external policies. From an American and a European perspective, a more geographically expansive approach to transatlantic cooperation — transatlantic relations for the other half of the Atlantic Basin — could emerge as a new strategic imperative.

The GMF-OCP program on the Wider Atlantic includes an annual Atlantic Forum in Morocco, and a set of research projects addressing key issues in an Atlantic Basin context. In the first year of the partnership, our research included studies on food security, energy, and Morocco's new geopolitics.

This report incorporates findings from the discussion on food security at the first Atlantic Forum, held in Rabat, June 17-19, 2011. Comments on the report are welcomed, and may be addressed to me, or the authors, at GMF.

Ian O. Lesser
The German Marshall Fund of the United States

Executive Summary

Joe Guinan

If the poor could eat words, then the challenge of global food security would largely have been met. The re-emergence of food security as a matter of pressing international concern in the wake of the 2007-2008 global food price crisis resulted in a flurry of research, analysis, and commentary by governments, academics, and practitioners, issuing forth in a blizzard of reports, public statements, and even a few action plans. Recognition is growing that recent changes in global agricultural markets are structural in nature and signal a reversal of the long-term downward trend of prices for agricultural commodities. Growing global population and wealth are increasing demand for food as resources are diminishing, soils are being depleted, and climate change is touching off fierce competition for water and land. Yields of the world's most important crops — rice and wheat — are rising more slowly than the number of mouths to feed, with experts predicting that global food production must rise by 70 percent by mid-century in order simply to keep pace with population. These long-term structural factors driving demand are here to stay and will continue to affect food prices for years to come.

The goal of this paper is not to duplicate or summarize this vast new literature on food security. Rather, recognizing that an adequate response to the challenge of global food security will require many elements, it is to suggest — from a transatlantic and wider Atlantic Basin perspective — the need for critical linkages that should be made in order to increase leverage in the use of scarce public resources and amplify the impact of international efforts to promote food security in Africa and increase their likelihood of success.

The Atlantic Basin perspective reflects the important role of all sides of the Atlantic, north *and* south, on the production side of the agricultural equation and the resources they bring to the table in terms of land, technology, and finance (both investment capital and development assistance). While a significant portion

of rising global demand for food stems from population increases and changing diets in Asia — particularly China and India — a large part of the solution will necessarily have to be found in the agricultural production and potential of the wider Atlantic region.

The regional focus on Africa stems from the simple fact that the continent, as the principal region of the world bypassed by the Green Revolution of the 1970s, is on the front lines of the global food security challenge. Home to half the world's uncultivated arable land, sub-Saharan Africa is the last great agricultural frontier. It is also home to over 40 percent of the world's hungry, and has the lowest caloric intake of any region — the only place in which the number of malnourished children is higher now than in the mid-1960s. And the situation is worsening. The recent global economic downturn hit Africa hard. Economic growth rates have fallen precipitously, and the number of people living in extreme poverty is on the rise. Most of these are smallholder farmers, and most smallholder farmers are women. The projections show that, without intervention on an unprecedented scale, Africa will be home to three-quarters of the world's hungry by 2025. A major humanitarian disaster is looming in what in historical terms is the mere blink of an eye.

A massive influx of public and private investment into African agriculture is needed to boost productivity and increase yields, which are lower in some places than they were during the Roman Empire. Ultimately, only capital markets can finance the scale of productive investment necessary to bring about this transformation. However, because of the perceived high risks associated with African agriculture and the complexity and expense of infrastructure and other constraints that have confounded the ability of private investors to address them, public sources of finance will be necessary to put in place catalytic investment. In an environment of constrained public resources around the world, food security will thus have to find ways to piggyback on other policy priorities, initiatives, and areas of public concern.

Having first introduced the issues, the following paper brings together an expert group of authors to look at three ways in which critical linkages should be made in efforts to promote food security in Africa.

Katrin Kuhlmann examines the African “Development Corridors” movement, which consists of using existing roads and railroads that link mines and other investments with regional markets and ports to bring farmers into a system that can move food, goods, services, and information. Given that so many of the continent’s countries are either landlocked without access to ports or so small that local markets cannot provide adequate scale to create economic opportunities, access to regional markets is particularly important in sub-Saharan Africa. The legacy of arbitrary colonial boundaries and fragmented markets has exacerbated the problems of poor policy and regulatory environments and held back regional trade. In response, African leaders have begun to coalesce around the Development Corridors, an innovative approach to market development first proposed by Nelson Mandela, which could do for Africa what projects like the Erie Canal did for development in the United States.

Next, Timothy Searchinger explores the need to link food security in Africa to climate change solutions, given the interrelated nature of these challenges, and the need to make available funds do double duty. Despite its tiny contribution to global gross domestic product (GDP), African agriculture generates a significant and growing share of world greenhouse gas emissions, while modeling analyses show that farming in Africa will also bear the brunt of climate impacts through droughts and higher temperatures that depress crop yields. The opportunities for synergies between climate mitigation and adaptation efforts and food security initiatives represent the most practical and economical pathways for making progress on both fronts through measures that boost agricultural productivity.

Taking advantage of the opportunities to address food security and climate goals together requires agreement on a shared vision for African agriculture based on strong productivity gains through techniques that also reduce production emissions, limiting export agriculture to high value crops, protecting forests, and prioritizing use of African farmland to boost production of staple foods. Such a vision will require significant financial support. At the Copenhagen climate change meeting in 2009, developed countries pledged to provide \$100 billion to developing countries for adaptation, mitigation, and general low carbon development. Although there

are challenges in coming through with these funds in a tough fiscal environment, the imperatives of climate change will eventually force action. Both the Reduced Emissions from Deforestation and Degradation (REDD) and the Nationally Appropriate Mitigation Activities (NAMAs) frameworks offer a means to deploy funding to meet dual climate and food security goals. But the best opportunity lies in making them work together.

Finally, the 21st century global agricultural economy contains a host of international actors from the wider Atlantic Basin and beyond. While China's role in Africa has received a lot of recent attention, Elisio Contini and Geraldo B. Martha, Jr. address the increasing role of Brazil in African agriculture and food security. Brazil-Africa agricultural trade is growing at a rapid pace. Brazil's emergence as an "agricultural superpower" in just four decades has attracted the attention of African leaders. Agro-ecological similarities between the Brazilian cerrado and African savanna have opened the door to technological cooperation. And a number of foreign policy initiatives — Brazil has opened 16 new embassies on the continent in recent years — have led to increased Africa-Brazil engagement on food security, particularly via Embrapa, the Brazilian Agricultural Research Corporation, which has been active in providing technical assistance and extension services to African agriculture with support from the highest levels of Brazil's political leadership.

This "Southern Atlantic" dimension to African food security — bringing together the resources of Latin America and Africa to realize the potential of the southern half of Atlantic Basin for trade, investment, and development based on solidarity and real interests — is of critical and growing importance. Any attempts to increase leverage through international coordination should find ways to incorporate not just U.S. and European interventions on food security in Africa but also those of Brazil.

Taken together, an increased focus on these linkages would be a significant contribution to current policy thinking and the long-run chances of success of the initiatives already underway to promote food security in Africa and beyond.

Introduction: Food Security and African Agriculture

Joe Guinan

Food security — defined since the 1996 World Food Summit as existing “when all people at all times have access to sufficient, safe, nutritious food to maintain a healthy and active life,” a definition that is commonly held to include both physical and economic access to food that meets people’s dietary needs as well as their food preferences — is back at the top of the international policymaking agenda. From a transatlantic perspective, food insecurity was last evident as a matter of pressing public concern during the Depression-era Dust Bowl in America’s Great Plains and in Europe in the aftermath of World War II, when large parts of the war-ravaged continent suffered from severe food shortages and food rationing had to be introduced and maintained for the best part of a decade. While hunger persists today on both sides of the North Atlantic as a result of poverty — nearly half of children in the United States today are recipients of food stamps at some point before the age of 20 — the overall productivity challenge of providing enough food in Europe and the United States has largely been met. Consumer preferences and concerns over nutrition, health, animal welfare, food safety, and product quality and variety have been eclipsing more traditional concerns over price and volume as a nascent “food movement” has been making its strength felt on both sides of the Atlantic.

In many regions of the world, however, the politics of food is less about good eating habits than the ability to eat at all. Despite the dire prognostications of neo-Malthusians down the years, predictions of widespread famines in the developing world in the 1970s as a result of population increases were effectively answered by the Green Revolution, in which the spread of new farm technologies generated huge increases in agricultural productivity in Asia and an abundance of food. While the world today is generally food secure on average, that average conceals a huge divergence in access to food by income level and geographic location, with more than a sixth of the world’s population

Shifts in the fundamentals of world agriculture have given rise to a new global food security challenge.

continuing to live in hunger.¹ Shifts in the fundamentals of world agriculture have given rise to a new global food security challenge.

This emerging 21st century food security challenge first garnered worldwide policy attention in large part due to the global food crisis of 2007-2008. Over just a few months,

the sudden spike in commodity prices left more than 100 million additional people without enough to eat. Riots broke out in countries around the world and governments wobbled and either fell, as in Haiti, or rushed to impose hasty export restrictions, further undermining already segmented global agricultural markets. World Bank President Robert Zoellick warned at the time that a decade of progress on hunger and poverty alleviation was in danger of being reversed. The food price spike was temporarily brought to an end by the financial crisis in the second half of 2008 and the resulting global economic downturn, with falling demand relieving the upward pressure on energy and commodity prices. However, even in the course of the worst economic downturn since the Great Depression, world food prices stayed fairly high and agricultural markets remained fragile and susceptible to further shocks.

The early months of 2011 brought a second global food crisis on the back of bad weather in Russia, Ukraine, and China.² The United Nations Food and Agriculture Organization's Food Price Index (FFPI) rose for the eighth consecutive month in February 2011, with world food prices soaring to all-time highs, surpassing even the peaks of 2007-2008. Wheat prices shot up by 74 percent, corn by 87 percent. According to the FAO, although the FFPI dropped back again in March from its peak in February, it averaged 232 points in May 2011, 37 percent higher than in May 2010. The World Bank warned at the time that another 44 million people have fallen into poverty as a result of rising food prices since the previous year. In 2011, for the first time in human history, the

¹ Andrea E. Woolverton, Anita Regmi, M. Ann Tutwiler, "The Political Economy of Trade and Food Security," International Centre for Trade and Sustainable Development, July 2010.

² Claire Schaffnit-Chatterjee, "Where are Food Prices Heading? Short-term Drivers, Trends and Implications," Deutsche Bank Research, March 10, 2011, www.dbresearch.com.

number of food insecure people worldwide surpassed the billion mark — a grim new milestone.

The unfolding global food crisis is, in the first instance, a humanitarian catastrophe. For the very poorest countries, many of them in sub-Saharan Africa, higher global food prices start a vicious cycle of hoarding, malnourishment, lower food production, and even higher prices.³ In 2008, more than 40 countries curtailed or completely closed down cross-border flows of food commodities as they struggled with the crisis. But these restrictions, however understandable as a panic response, served only to further exacerbate the problem, narrowing markets and driving prices still higher. Large surpluses in some countries were thus unable to reach hungry people just over the border. Smallholder farmers, whose greatest asset is their own labor, withdraw to subsistence strategies if they cannot count on a broad market for their harvests, further reducing the food supply. Since early 2011, the Horn of Africa has been suffering through a devastating food security crisis impacting more than 10 million people. At particular risk are the millions of people — largely women and children — who already live at the margins of existence. For them, a small disruption in food supply can lead to long-term physical and mental damage and even death.

Food insecurity also has geostrategic consequences, with soaring prices contributing to political turmoil. Bread riots are among the oldest forms of social unrest, and the rising cost of food was a trigger in last year's uprisings in North Africa and the Middle East, dubbed the "Arab Spring." Hardly felt in the United States and Europe, where basic commodities are a small portion of the total cost of diets comprised largely of processed food, spikes in commodity prices are felt much more acutely in developing countries. The densely-packed cities of North Africa, heavily reliant on imported food, are particularly vulnerable. Although it is impossible to know to what extent, last year's food crisis fed

Bread riots are among the oldest forms of social unrest, and the rising cost of food has been a trigger in this year's uprisings in North Africa and the Middle East.

³ John Simon and Susan Sechler, "Africa's once-and-future food crisis," *Politico*, March 9, 2011.

into the revolts and uprisings in Tunisia, Egypt, Libya, Yemen, and elsewhere.

The onset of the second food crisis in less than three years put the world on notice that we have now definitively entered a new phase of global agricultural production and consumption. The commodity markets of the future will be characterized by increased volatility and recurring price shocks on the basis of a reversal of the long-term downward trend of prices for agricultural commodities. Price fluctuations are being driven by a combination of a short-term supply shocks and longer-term structural growth in demand. In the short-term, supply-side factors such as weather events and related shortfalls in production, together with oil prices, exchange rates, and policy decisions such as export bans have all contributed to the food price spikes.

Beyond short-term market conditions looms the long-run question of how to feed a growing and changing world. The planet's population surpassed 7 billion this year and will top 9 billion by mid-century. Demand for food will only continue to rise, with experts predicting that even by conservative measures global food production must increase by 70 percent simply in order to keep pace with the number of mouths to feed. Changing diets, income growth, urbanization, natural resource constraints — particularly water availability — and a slowdown in the growth of yields of wheat and rice, the world's most important staple crops, due to decades of underinvestment in agricultural research and development will only compound the problem, as will the effects of climate change.

The need to sustainably increase food supply in the long term could also present great opportunities for agriculture-led development for some of the world's poorest people and regions.

The long-term structural factors driving demand are here to stay and will continue to affect food prices for years to come. How policymakers respond will be critical. Absent the right interventions, this is a recipe for humanitarian catastrophe and political unrest that will touch all sectors of the world economy and have profound implications for security and global governance. But the need to sustainably increase food supply in the long term could also present great opportunities for

agriculture-led development for some of the world's poorest people and regions. Changes in agricultural production and farm practices among smallholders in regions bypassed by the Green Revolution hold out the prospect of massive productivity gains and improvements in yields and could form an important part of rebalancing global supply and demand. Foremost among these regions is Africa.

Africa's lack of functioning food markets has hampered broader economic development and continues to keep the continent on the sidelines of the global economy.

The Challenge of African Agriculture

In recent decades, economic growth has been the engine that has allowed hundreds of millions of people around the world to lift themselves out of poverty, many of them in Asia. This growth largely bypassed rural areas of sub-Saharan Africa, which still lack fully functioning food economies. While agriculture is the largest contributor to gross domestic product, national income, and domestic consumption in sub-Saharan Africa, as well as the biggest source of hard currency earnings, savings, and tax revenues, and the main provider of industrial raw materials, its potential still remains largely untapped. Africa's lack of functioning food markets has hampered broader economic development and continues to keep the continent on the sidelines of the global economy.

As a consequence, agriculture has delivered little real benefit for most African farmers and consumers. In recent years, per capita food output in sub-Saharan Africa has been around one-fifth of 1970 levels, making Africa the only region of the world where per capita food production has declined in the last three decades. To make up for lagging productivity rates, African farmers expanded production onto new land, often clearing forests and further stressing depleted soils. Over the same period, Africa's share of world trade fell in nine out of ten of its major export crops, and imports have soared even in commodities Africa can easily produce, making the continent a net importer of food. As a consequence, agriculture in sub-Saharan Africa generates \$2 per day or less in income for the vast majority of the hundreds of millions of people it directly supports.

Until relatively recently, economists and development experts believed that Africa should “jump over” agriculture and proceed on the basis of growth in other economic sectors, such as manufacturing and services. However, the failure of these development models to impact the baseline of hunger and poverty on the continent has resulted in a widespread acceptance that sustained economic growth in Africa and the improvement of the lives of hundreds of millions of Africans will not occur unless Africa can feed its growing population. Such models also failed to take into account Africa’s productive capabilities and the fact that its true potential lies in agriculture. Africa has around 20 percent of the world’s arable land, but less than 10 percent of this land is cultivated. Accordingly, Africa’s economic development will require a vibrant and growing agricultural and food sector.

Africa must dramatically increase agricultural productivity, production, and efficiency over the next decade.

Africa must develop market-oriented, integrated, sustainable, and competitive agriculture and food systems capable of generating agricultural surpluses and selling them to support broader growth in the economy. This will help create opportunities for the millions of African farmers who will ultimately leave agriculture while at the same time bringing the remaining smallholder farmers into commercial relationships in the food sector. To do this, Africa must dramatically increase agricultural productivity, production, and efficiency over the next decade. It will need new crops and varieties, more irrigation and inputs, geographical shifts in agricultural production, and better access for farmers to functioning infrastructure that can both bring in supplies at affordable prices and efficiently move production to market. Unless African agriculture is to become a significantly larger contributor to global greenhouse gas emissions and climate change, this will have to be achieved on the same footprint — or even a smaller one.

Facilitating this outcome will require an unprecedented level of cooperation and alignment among African governments, donors, and the private sector. Donors must play a catalytic role, improving infrastructure and finding ways to use their social risk capital to leverage more investment from the private sector. Governments must remove the barriers to increased productivity and efficiency.

Businesses must build efficient supply chains that enable African consumers to purchase nutritious foodstuffs for 12 months of the year. Together, this will make possible a virtuous circle of increased productivity and incomes.

Many of the problems that have kept Africa's agricultural economy from taking off in the past are still widespread today. The first is the lack of economic empowerment for women. Women grow, store, and transport 80 percent of the food in Africa, but they and their children are far more likely to be undernourished than men. Women are responsible for much of the agricultural innovation, but receive only 10 percent of the extension services and financial support that is available from governments and own title to less than one percent of the land. Women (and their children) are the first to suffer from the failure of agricultural development, and they suffer on both ends — both as smallholder farmers and as consumers. Further, when the implications of low productivity become apparent at the farm-level, the girls are the first to be taken out of school and put to work in the fields.

Lack of political clout is also a problem. Despite their numbers, rural populations have little political power in Africa. Most of the capitals of Africa's coastal countries are seaports; most of the farmers are in the hinterlands far from the sea. Governments have found it easier to feed urban areas with shipments from abroad — often concessional sales provided through aid — in the absence of political pressure to develop the means to transport food from domestic farmers in far-flung and remote interiors. The problem is also one of missing public goods, in the form of the government support necessary to build the storage capacity, roads, and information systems that are the underpinnings of functioning markets that would serve both the commercial and small farm sectors. It is not only that the infrastructure to connect rural areas with urban markets was not built, but also that there are no policies and programs to connect smallholder farmers to the infrastructure that does exist.

Most smallholder farmers and their households thus survive year to year in what is effectively a closed system, isolated and with poor

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access to transport and market information, using few purchased agricultural inputs such as fertilizer or pesticides, consuming much of what they produce, and having virtually no ties to the formal economy. The lack of transport and storage facilities means that much of the food produced in Africa is lost: an estimated 25 percent of food grains are not consumed, while losses among less hardy crops like fruits and vegetables and root crops can be as high as 50 percent. These losses are not only economic: increased consumption of fruits and vegetables is important for improving nutrition and health.

The vicious circle of limited reach and high aversion to risk because of extreme vulnerability has come about because of underinvestment in African agriculture from both public and private sources. Opportunities to take small steps towards better conditions have emerged through aid-funded initiatives or new government policies, but the well-documented small-farmer experience is that these efforts are not sustainable and usually fail or fade away. When the donor support dries up, the farmers return to survival mode and are no better positioned to meet the basic needs of their families. This has been the tragic outcome of millions of dollars in donor aid programs.

The different sectors of Africa's food economy largely exist as worlds apart. The huge small-farm sector stands in marked contrast to the small commercial sector, which represents as little as 2 percent of agricultural production in some countries. Smallholder farmers interact with the commercial sector mainly as laborers on large farms, in processing plants, or through contract-farming arrangements. Poor policy choices in the public sector have constrained the success of both the commercial and the small-farm segments of African agriculture. African governments and donor countries and institutions have shown a relative lack of interest in agriculture. Unequal terms of trade have been imposed by developed countries on Africa and by African countries on each other. In addition, the historic failure to invest in storage, roads, railways, and ports has left the region with a desperately inadequate transport system that adds hugely to import costs and export prices. Much of this is the result of poorly informed and sometimes deliberately obstructive government policies, especially toward the commercial farm sector.

The failure to develop a market-oriented, integrated agricultural economy in Africa capable of generating and recycling agricultural surpluses has been catastrophic for Africa's overall economy. Agricultural development has proven an essential prerequisite to overall national economic growth in all countries, and economic growth is an essential component of food security. Agrarian economies like Africa's need agricultural surpluses to develop. If there are surpluses that can be marketed, they will generate net income not only for the farmer and her family, but also for the national economy via taxes paid to governments and the recirculation of that investible surplus through the banking system, paving the way for new businesses, roads, and other investments in the wider economy. This virtuous circle of development has not occurred in much of Africa.

The implications of this have been profound. Per capita food production in Africa is 19 percent below its 1970 level, and farm productivity is only one quarter of the global average. An increasing share of Africa's food consumption comes from imports, and much of those come in the form of international and bilateral aid. For the foreseeable future this will remain the case, although some of the most creative aid programs are attempting to combine stimulating Africa's own small farm sector with these import programs and are filling gaps in Africa's food system. However, much more is needed if agriculture is to provide the engine for poverty alleviation and economic growth in Africa, as it has in virtually all successful economies.

Attaining real and sustainable food security for the continent requires growth, and this means finding ways to provide Africa's farmers and entrepreneurs with the tools to transition away from subsistence farming and toward market-oriented production systems. A key lesson of agricultural development everywhere is that market-led opportunities are a more powerful driver for small farm productivity than donor assistance.

To successfully develop African agriculture, the public sector — both African governments and donor countries and institutions — has

A key lesson of agricultural development everywhere is that market-led opportunities are a more powerful driver for small farm productivity than donor assistance.

a critical role to play. Building a food economy that makes a nation or region food-secure requires combining public support with private investment. Africa has over 50 countries and a land mass more than three times that of the United States. Distances are great, infrastructure is poor, and African governments have often adopted policies that impede the free flow of people, goods, and services from rural areas to urban markets as well as across national borders. In terms of external challenges, donor policies and programs are poorly aligned with each other, and development policies are not aligned with trade and investment policies. All this prevents the development of crucial regional markets and, therefore, of food security in Africa.

Poor governance — both corruption and ineffectiveness — has been and remains a significant barrier to progress. However, this picture is beginning to change, particularly in areas with a high potential for commerce. The Regional Economic Communities (RECs) in Africa are becoming more effective governance structures, and there have been few if any charges of corruption leveled at them or at other regional or supranational structures in Africa.

Much of the task of transforming African agriculture will fall not just to Africans but to external governments and donor agencies as well.

But much of the task of transforming African agriculture will fall not just to Africans but to external governments and donor agencies as well. It will require a thorough alignment of public and private investment by means of carefully crafted and transparent public-private partnerships with accountability factored in, and advocacy for policies that empower market-based economic development.

Although donors have voiced strong support for the regional and supranational integration required for a transformation of African agriculture to occur, this has not been well supported by donor governments in practice. Their policies on aid, trade, and investment are often inconsistent with this commitment and sometimes even limit rather than expand opportunities. Trade capacity building and other aid programs are often fragmented and politically driven, rather than targeted to address specific barriers, support competitive industries, and build regional markets.

Domestic interest groups in developed countries have dominated the debates on trade at the expense of African producers, who have lacked the resources, information, and access necessary to ensure that policies address their needs. Institutionally, different agencies and legislative committees in different countries either lack the broad mandate necessary to develop comprehensive policies or are reluctant to coordinate with one another for political reasons. Finally, donor policies in the United States and elsewhere are primarily focused on bilateral relationships with African governments rather than on building regional cooperation.

The picture is not entirely bleak. A number of factors suggest that the story of agriculture in Africa may well be about to enter a new and more uplifting chapter. After decades of neglect, African governments have at last begun to allocate greater attention, resources, and effort to the agricultural sector, aware that the continent has so much available but underutilized land and that enabling Africa to feed itself and become a food exporter is now a strategic concern and attainable objective. At the pan-African level, macroeconomic and democratic reforms, rising natural resource and commodity prices, and growth in real estate, telecommunications, and banking led to a 7 percent growth rate sustained for ten years through 2007. This recent track record is looking much shakier since the global economic crisis but has strong structural roots and there are hopes for a similar performance in the future. It is possible that this will give rise to more intra-regional trade and growth in regional demand for previously untraded staple foods produced by smallholder farmers.

The very statistics that underscore Africa's agricultural underdevelopment can also be read as a source of optimism for the future. Only 24 percent of African smallholder farmers use improved seeds in cereal production — compared with 77 percent in South Asia. Less than 4 percent of cultivated land is irrigated, and fertilizer is used at a rate of 13 kilograms per hectare in sub-Saharan Africa compared to 190 kilograms per hectare in East Asia. Crop losses due to lack of on-farm storage cost Africa's farmers 30 percent of their income each year, and mechanization rates stand at somewhere between 1 and 10 percent of the world average. These figures suggest opportunities for substantial improvements in productivity in the future — and they are predicated not on radical

Donor funding must be catalytic, triggering more private capital flows, and not operational if really large numbers of Africa's smallholder farmers are to benefit.

new practices but on the deployment of very basic existing, well known, and widely used techniques.

Whether Africa's underutilized resources can be brought rapidly into use to realize the continent's potential to feed itself is still an open question. Even with the additional resources generated by the increased prioritization of global food security, there is simply not enough donor money available for donors to pay directly for major improvements

in the livelihoods of Africa's hundreds of millions of subsistence farmers. Donor funding must therefore be catalytic, triggering more private capital flows, and not operational if really large numbers of Africa's smallholder farmers are to benefit. It is not clear that this will be the case with many of the donor initiatives currently underway.

Responses to the Food Crisis

The 2007-2008 food crisis resulted in an unprecedented level of global public attention and political commitment to tackling the problem of food insecurity. At the G8 summit in Italy in July 2009, the leaders of the advanced industrial countries issued the *L'Aquila Joint Statement on Global Food Security*, expressing their commitment to "take decisive action to free humankind from hunger and poverty through improving food security, nutrition, and sustainable agriculture" and pledging to mobilize \$22 billion over three years for a global effort "characterized by a comprehensive approach to food security, effective coordination, support for country-owned processes and plans, as well as by the use of multilateral institutions whenever appropriate." The *L'Aquila* communiqué went beyond emergency response and food aid and placed a strong focus on the development of agricultural markets, trade, and rural economic growth as the cornerstones of food security. It promised to create a "Global Partnership for Agriculture and Food Security" as part of a renewed effort to accelerate progress and reach the first Millennium Development Goal of halving the number of people living in extreme poverty and suffering from hunger and under-nutrition by 2015.

The political attention and increased resources presently being devoted to global food security have created a new international policy and business environment that provides a window for a fundamental change of approach on the part of governments, donors, and the private sector. A number of significant initiatives are underway on the bilateral, regional, and multilateral levels.⁴ The European Union has created a €1 billion Food Facility (EUFF) and launched the EU Joint Programming Initiative on Agriculture, Food Security, and Climate Change (JPI). At the multilateral level, the United States, Canada, Australia, South Korea, Ireland, and Spain together with the Bill & Melinda Gates Foundation have collaborated in setting up a trust fund — the Global Agriculture and Food Security Program (GAFSP) — at the World Bank as the primary mechanism for disbursing funds that materialize as part of the \$22 billion pledged at the L'Aquila Summit. In Africa itself, the Comprehensive Africa Agriculture Development Programme (CAADP) has been launched to extend sustainable land and water management practices, improve rural infrastructure and trade-related capacities for market access, raise smallholder productivity, respond more effectively to food emergencies, and improve agricultural research to disseminate new technologies.

Since L'Aquila, the United States has been playing a strong leadership role on food security, launching the “Feed the Future” initiative based on a whole-of-government approach and promising \$3.5 billion from fiscal years 2010 to 2012. Feed the Future is organized around five broad principles (with specific actions to be taken under each category): 1) comprehensively addressing the underlying causes of hunger; 2) investing in country-led plans; 3) improving strategic cooperation; 4) leveraging the benefits of multilateral mechanisms; and 5) making a sustained commitment to be held publicly accountable.

The priorities at the heart of the Feed the Future initiative — which include improving emergency responses to food crises, improving nutrition, strengthening social safety nets, improving agricultural development and smallholder productivity, building local capacity, catalyzing the private sector, and prioritizing directing assistance

⁴ Farming First has produced a very useful interactive map of food security initiatives currently underway around the world, which can be found at www.farmingfirst.org/foodsecurity/.

to women and children — are the right ones in terms of avoiding the looming crisis facing African agriculture. However, critical elements are currently missing from the strategy in terms of implementation without which the food security initiative will struggle to achieve success. As it stands, the initiative does not address fragmentation within and among U.S. government agencies. It does not provide for a robust alignment with the rest of the donor community — especially European and other governments with a similar perspective and approach. Despite a stated commitment to working in partnership, it does not provide the means for all of those who need to cooperate across civil society and the private sector to do so. It does not have mechanisms for developing new models for partnership on the ground that include transparency and accountability. And it does not have a way to monitor and measure progress and evaluate the benefits of policy changes and investment interventions, and is thus vulnerable to waning political support on Capitol Hill in the absence of a way to demonstrate “results.”

More generally, to date only a portion of the funds promised in L'Aquila has materialized. The era of fiscal austerity following the financial and economic crisis is leading to a retreat from the G8 commitments. As public budgets are slashed, there are even proposals for cuts in emergency food aid. The imperative to ensure that scarce resources are fully leveraged is more pressing than ever. There is also a growing international coordination challenge. In Tanzania alone, the World Bank counted more than 240 organizations and agencies at work on donor-financed agricultural projects. Without greater alignment and coordination, the risk is that current food security initiatives will go the same way as past project-by-project aid-driven approaches and bleed away the available resources without any real or lasting impact.

If African countries and donors do not develop Africa's agricultural potential, it is clear that outside investors will.

If African countries and donors do not develop Africa's agricultural potential, it is clear that — given the pressure of rising global demand for food — outside investors will. While policymakers struggle to put in place a concerted response to the challenge of food insecurity in Africa, events on the ground are continuing to move rapidly. In anticipation of

a future in which their own populations will outgrow their ability to feed them, investors from countries as diverse as Saudi Arabia, India, South Korea, and Qatar have been looking for arable land on which to establish plantations to produce rice and other staple crops in African nations like Ethiopia, Sudan, Tanzania, Kenya, and Mali. These leases are generally long-term and include tax holidays, with few environmental, labor, or social safeguards. They have caused civil unrest in some countries. The Malagasy government fell after a scandalously one-sided agreement was revealed with South Korean Daewoo Logistics to take over half of Madagascar's arable land to grow crops for export without paying rent. Experts are warning of a neocolonial grab for African land.

If land grabs continue without concern for smallholder farmers, it could result in a dismal rerun of colonial-era extractive models of investment that do little or nothing to benefit Africa.

Since 2007, tens of millions of acres of land on the African continent have been leased by foreign investors looking to ensure the food security of their own populations. Ethiopia alone has approved more than 800 foreign-financed agricultural projects since 2007. China has signed a contract with the Democratic Republic of Congo to grow 6.9 million acres of palm oil for biofuels, while European biofuels companies have acquired or requested another 10 million acres in Africa.

This growing interest in Africa's agricultural potential represents an enormous opportunity, but the manner in which the investment occurs will be critical to whether or not it leads to enhanced food security for Africa's people. If land grabs continue without concern for smallholder farmers, it could result in a dismal rerun of colonial-era extractive models of investment that do little or nothing to benefit Africa. Different types of investment and different business models for agriculture in sub-Saharan Africa are urgently needed to show investors — and African governments — that there are ways to deliver both commercial and social returns that will lead to better development outcomes and enhanced food security. Alongside the new models of investment it will be important to insist on mechanisms for transparency and accountability, so that Africans can shine a light on the corrupt practices that lead their governments to participate in these one-

The challenge is to find ways to leverage the available resources that will allow for the emergence of food and agriculture as Africa's new source of economic dynamism.

sided leasing agreements, bringing pressure on governments and investors to do business in ways that extend the benefits of these investments to Africans themselves.

Africa's food future is now. Changes are happening in markets, among donors, and in African governments and leadership organizations that could make the vision of greater food security on the basis of a booming African food economy possible. The shifting fundamentals of the global food system and the unprecedented international political

commitment to food security mean that there is a window of opportunity to align public and private investment in support of an integrated commercial and small-farm approach to African agriculture that could redress the failures of past approaches and policies. The challenge is to find ways to leverage the available resources and make the critical linkages that will allow for the emergence of food and agriculture as Africa's new source of economic dynamism over the coming decade.

The following report lays out three of the possible areas in which such leverage can be achieved, each of which holds out the prospect of high returns. It takes an Atlantic Basin perspective because, although the causes of the food crisis are truly global and the impacts are already being felt far beyond the boundaries of Africa, the wider Atlantic Basin region will have a critical role to play in increasing agricultural production and ensuring future food security. If much of the increased pressure on the global food system from the demand side stems from Asia — in particular, from growing population and wealth and changing diets in China and India — then critical elements of a supply-side response will have to come from the wider Atlantic Basin, north and south. The resources and potential of this region — in terms of land, labor, capital, technology, agricultural inputs and maritime and trade relations — are huge. With the partial exception of foreign investment, it is the wider Atlantic Basin that is the most likely source of much of what Africa requires to bring about a much-needed transformation of agriculture and food production on the continent.

I. Africa's Development Corridors: Pathways to Food Security, Regional Economic Diversification, and Sustainable Growth

*Katrin A. Kuhlmann*⁵

Africa's Growing Food Crisis

Sub-Saharan Africa is at a crossroads of tremendous opportunity and significant challenge. With half of the world's uncultivated arable land, the region is both the last great agricultural frontier and a locus of vast humanitarian catastrophe in the making, a building crisis of hunger and food insecurity that will only be exacerbated by climate change.

Home to 12 percent of the world's population, Africa today has 44 percent of the world's hungry. Millions of African men, women, and children struggle to exist on less than \$2 a day, living in isolated rural areas and depending upon what little they can grow for most of their living. Yet recent events have shown that this desperately sad situation is not static. As global population and wealth increase, demand for food is increasing within Africa and throughout the world. If harnessed to Africa's advantage, this new demand could represent an enormous opportunity for Africa's poor farmers and consumers as well as a platform for agriculture-led growth throughout the economy. But absent such a transformation, if current trends are allowed to prevail, sub-Saharan Africa's share of

⁵ Katrin Kuhlmann would like to thank Susan Sechler for her insightful suggestions and contributions to the argument of this paper and Jung-ui Sul and Fatoumata Barry for their research support. The analysis in this paper has appeared in prior works by the author and TransFarm Africa. See, e.g., "Africa's Development Corridors as Pathways to Agricultural Development, Regional Economic Integration and Food Security in Africa," Katrin Kuhlmann, Susan Sechler and Joe Guinan, Draft Working Paper, June 15, 2011 (Aspen Institute, Washington, D.C.).

It is clear that if Africa does not develop its food production resources for its own people, others will develop them for theirs.

the world's hungry is projected to increase to 75 percent by 2025. Most of these people will live in rural areas.⁶

Much depends on the response of international capital markets, the donor community, private sector companies, African governments, and, above all, Africa's entrepreneurs. So far, most are moving in the right direction, but the scale,

pace, and scope are still too constrained relative to the need and the opportunities that are unfolding. Recent history has shown what the future might look like if the current course is not corrected and the response not accelerated. In the past three years, rising global prices and strong demand, coupled with the weakness and isolation of much of the African small farm sector, have led to two major food price crises, resulting in destabilizing bread riots in urban areas and an upsurge of deprivation among the poorest, while triggering a rash of national export restrictions that only pushed prices still higher.

The increase in global population and wealth has also touched off an intense competition for Africa's land and water resources. This makes it both more difficult and more important for Africa's farmers to take advantage of global demand by becoming the backbone of thriving regional food systems capable of feeding the continent's swelling numbers and reducing the dependence on expensive food imports. It is clear that if Africa does not develop its food production resources for its own people, others will develop them for theirs.

A new ramped-up approach is needed, and needed quickly, as the window of opportunity to put Africa's tremendous agricultural production potential to use to feed its people and spur economic growth is closing. Climate change is taking an increasing and unexpectedly rapid toll, threatening to cut rain-fed farm yields by half, with severe impacts for the vast preponderance of African

⁶ International Food Policy Research Institute, "Assuring Food and Nutrition Security in Africa by 2020" (2004).

farming.⁷ Left unchecked, the deterioration of Africa's productive capacity will not only continue to wreak havoc in the region but will be felt acutely worldwide.

African Agriculture's "Missing Middle"

There is no simple solution to these problems. Africa's ability to realize its economic potential and put its people on a path to prosperity and food security will depend upon its ability to build the current collection of fragmented and isolated communities and underdeveloped, disconnected markets into an integrated, diverse African regional economy capable of both creating opportunities within Africa and trading with the rest of the world. This is a heavy lift. Only by developing more efficient, equitable, and extensive market systems that link Africa's vast food production potential to growing demand can current efforts to achieve sustainable food security be realized.

The potential to take this huge but essential step exists in part because Africa's significant resources remain underutilized. Africa possesses nearly 20 percent of the planet's arable land, but less than 10 percent of this land is cultivated at present. Most of Africa's production across commodities, including its vast and largely untapped mineral deposits and virtually all of its agricultural products, leave the continent without any additional processing or value added.

Africa's agricultural sector spans two vastly different worlds: a small commercial sector capable of obtaining financing for its operations and turning a profit, and a vast, largely subsistence small farm sector that operates outside of systems for getting capital or selling goods. Between the two lies African agriculture's "missing middle," the underdeveloped link in value chains that will build productive systems and tie smallholders into the stream of commerce. The majority of Africa's untapped human

Only by developing more efficient, equitable, and extensive market systems that link Africa's vast food production potential to growing demand can current efforts to achieve sustainable food security be realized.

⁷ The Intergovernmental Panel on Climate Change warned in its 2007 report that by 2020 climate change could lead to a 50 percent cut in rain-fed farm yields in many African countries (Intergovernmental Panel on Climate Change, *Climate Change 2007 Synthesis Report*, 2007). As much as 96 percent of African agriculture is rain-fed rather than irrigated.

resources engaged in agriculture — approximately 600 million small producers — exist at present largely outside of mainstream market systems, lacking capacity and technical knowledge and cut off from the established commercial enterprises that could provide a link to larger, more profitable markets. Focusing on this “missing middle” will unlock new innovation in African agriculture and is the key to developing a vibrant agricultural economy. Functioning market systems that effectively integrate smallholder farmers would open up a realm of possibilities beyond subsistence farming and enable farmers to sell more of what they produce, giving rise to increased productivity, higher incomes, and lower and more stable food prices.

From a broader developmental perspective, enhancing regional markets and connecting farmers to them is absolutely essential. Not only would markets open up economic opportunities, they would give farmers and their families access to additional goods and services, including education and life-saving health care.

Altogether, the emergence of a market-oriented, integrated agricultural economy in Africa capable of generating and recycling agricultural surpluses would set the stage for the tremendous exodus from agriculture that must ultimately take place, providing better opportunities for those leaving farming and enhancing their ability to take advantage of those opportunities through better education, health, and connection to the modern world. The farmers who stay behind would themselves be part of a vastly more efficient and lucrative production system — a genuine *food economy*.

Given the magnitude of the challenge, solutions cannot be anything but comprehensive in their approach. Fortunately, one such solution exists in the “Development Corridors,” an African framework that presents an innovative approach to market development by using existing roads and railroads that link mines and other investments with regional markets and ports to build a system that can open up opportunities for farmers and move food, goods, services, and information. The promise of the Development Corridors starts from the central role trade must play in Africa’s economic and food future and unlocks tremendous new opportunities in agriculture and across Africa’s economies.

With greater institutional support and resources, the Development Corridors could be a key to unlocking regional investment and market development. If pursued with political support, strong and inclusive governance, the right international policies, and a focus on agriculture and equitable growth all along value chains, the Development Corridors stand to revolutionize African agriculture, enhance food security, and create much-needed opportunities for economic diversification and sustainable development.

The Role of Trade and Markets in Increasing Food Security

Building the political will to promote the kind of investment and trade interventions that are required for Africa's development will require that African governments, donors, and the private sector recognize trade's importance in both broader development and food security. Bluntly stated, Africa will remain underdeveloped and food insecure if markets are not improved and Africa's trade, both regionally and with the rest of the world, is not increased. It is essential to make generating the business and investment climate necessary for trading systems to work efficiently — at all stages from production to consumption and from the local level to the international — a priority.

Africa's potential for enhanced trade remains untapped, and there is no question that the continent is currently an “under-trader,” with the potential to go well beyond its current tiny share of world trade.⁸ Most African economies are isolated and underdeveloped, with few products to trade. These economies have failed to diversify and have seen falling market shares for traditional exports.⁹

Another reason that African agriculture has been unable to take advantage of growing global markets for food is that the different

The promise of the Development Corridors starts from the central role trade must play in Africa's economic and food future and unlocks tremendous new opportunities in agriculture and across Africa's economies.

⁸ Africa's share of world exports has declined sharply, going from about 5.5 percent in 1975 to about 2.5 percent in 2002. These losses in world trade have cost Africa almost \$70 billion per year. Bora, Bouet and Roy, 2007.

⁹ Saswati Bora, Antoine Bouet, Devesh Roy, “Research Brief: The Marginalization of Africa in World Trade,” Washington, DC: IFPRI Brief, 2007.

Commercial agriculture in Africa has lost market share in 90 percent of its export products and has failed to penetrate domestic regional food markets because of its weak links to African consumers and the smallholder farmer segment.

sectors of Africa's food economy exist as worlds apart. The enormous size of the small-farm sector stands in stark contrast to the small size of the commercial sector, which has a disproportionately low share of sub-Saharan Africa's agricultural production — as low as 2 percent in some countries. Cash crops such as coffee, cacao, and cotton are the exception, with much higher commercial percentages, but these crops represent a small percentage of African agriculture overall.

Major gaps in the food production value chain and high front-end costs limit the attractiveness of investment opportunities. Consequently, regional reliance on food imports has grown speedily; commercial

agriculture in Africa has lost market share in 90 percent of its export products and has, at the same time, failed to penetrate domestic regional food markets because of its weak links to African consumers and the smallholder farmer segment.

The gap between the top of Africa's agricultural pyramid and the very large base of smallholder farmers robs both of opportunities to become integrated into more dynamic and diverse regional food systems like those that exist in the United States and Europe. Smallholder farmers are denied the benefits of learning from the commercial agricultural sector and are barred from the potential for spin-off industries, upward mobility, and increased productivity that comes from being linked to markets.

On the other side, this disconnect also robs the commercial sector of opportunities to expand commercial production and develop regional markets that could provide the African consumer with a more diverse and reliable array of nutritious foodstuffs than one limited to locally-grown crops. Most of the commercial food sector's links to finance, production, distribution, marketing, and trading are in the international economy, and it has had little success selling into local or regional markets in Africa. In African agriculture, as in mining and forestry, the vast majority of exported commodities leave the continent without any processing, cutting

off the potential for added income from its products.

Enhanced trade will provide opportunities that can strengthen the “missing middle” in African agriculture and provide incentives for the commercial sector to work with smallholder farmers, contributing to economic growth and giving rise to accompanying increases in income and access to food. It will also expand the availability of food by buttressing domestic food supplies and opening up access to new crop varieties and technologies.¹⁰

Not surprisingly, African regional trade remains well below its potential. Having access to regional markets is particularly important in sub-Saharan Africa, where so many countries are either landlocked without access to ports or small enough that local markets cannot provide adequate scale for demand to create economic opportunities. Of the 30 landlocked developing countries worldwide, half are in Africa, as are 16 of the world’s 34 coastal transit countries that provide critical port access for these landlocked countries.¹¹ In terms of size, 35 percent of Africa’s countries have populations of fewer than 5 million and nearly half have populations of fewer than 10 million.¹²

Ensuring the physical movement of food from areas of surplus to areas of deficit is perhaps the most critical function of Africa’s markets. The legacy of arbitrary colonial boundaries and past power struggles has meant that moving food from areas of surplus

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¹⁰ Michiel van Dijk, “African Regional Integration: Implications for Food Security,” Agricultural Economics Research Institute (LEI), March 16, 2011. Available at: <http://ssrn.com/abstract=1788157>.

¹¹ Jack I. Stone, “Infrastructure Development in Landlocked and Transit Developing Countries: Foreign Aid, Private Investment, and the Transport Cost Burden of Landlocked Developing Countries,” Geneva, Switzerland, UNCTAD/LDC/112, June 28, 2001.

¹² Steven Haggblade, “Unscrambling Africa: Regional Requirements for Achieving Food Security,” Michigan State University, October 2010.

Fragmented and arbitrary market designations have left many of Africa's poor and landlocked countries at the mercy of their neighbors' infrastructure and policy environments.

to areas of deficit is often prevented.¹³ These fragmented and arbitrary market designations — accompanied by incredibly burdensome policy and regulatory environments — have left many of Africa's poor and landlocked countries at the mercy of their neighbors' infrastructure and policy environments. Not surprisingly, regional trade in both agriculture and food has increased only moderately over the last two decades, with the biggest gains in Eastern and Southern Africa.¹⁴

Better access to regional markets will also encourage farmers to produce more, increasing incomes and increasing the availability of food for Africa's hungry. Currently, many African farmers, the vast majority of whom are women working to feed their families, are not connected to market systems at all, making food difficult to come by despite the fact that most African economies are so heavily focused on agriculture.¹⁵ In a year when crops are good, these farmers are able to sell and barter surplus produce in village markets, but because they cannot reach larger markets, they lack the motivation to consistently produce surpluses, even if it were possible. No farmer will look to produce more than the family can consume if she can neither store nor sell that surplus.

Many of the problems that have held back Africa's trade in the past are still widespread today. Unlocking Africa's untapped potential for expanded trade and equitable development will depend upon improving both hard and soft infrastructure. Hard infrastructure — meaning roads, railways, ports, and energy systems — is notoriously weak and underdeveloped in Africa. In many cases, infrastructure simply does not extend to the rural areas that need

¹³ For example, political borders “separate surplus millet and sorghum producers in southern Mali and Burkina Faso from deficit markets in half a dozen surrounding countries; surplus maize- and bean-producing zones of Uganda from deficit markets in Kenya, southern Sudan, and Rwanda; food surplus northern Mozambique and southern Tanzania from intermittently deficit markets in Malawi and eastern Zambia; and livestock exporters in Mali, Mauritania, and Niger from coastal markets all across West Africa.” Haggblade, 2010.

¹⁴ Regional trade in agriculture has increased from 15 percent to 19 percent; regional trade in food has increased from 15 percent to 20 percent.

¹⁵ In some countries, up to 90 percent of rural livelihoods are focused around agriculture. World Bank, *World Development Report 2008: Agriculture for Development*, Washington, DC 2008.

it most. The World Bank estimates that half of infrastructure projects in Africa are not placed where they would need to be in order to maximize economic benefit.¹⁶ Furthermore, only about 20 percent of public investment in infrastructure historically has gone to rural areas.¹⁷

While physical infrastructure concerns are significant, gaps in Africa's policy, regulatory, and institutional systems — “soft” infrastructure — and the numerous supply-side and capacity challenges facing farmers and other producers alike present perhaps the greatest obstacles and if addressed can yield significant results. But this will require both political will and the shared efforts of both government and the private sector. Currently, despite the signature by African governments of numerous agreements to the contrary, Africa's national and regional markets are still blocked by a host of barriers that limit opportunities for trade and investment. As a result, Africa's markets are often unable to generate economies of scale sufficient to attract the sort of private sector interest needed to fuel growth, increase exports, and, ultimately, spur poverty alleviation.

Given Africa's vast size and the pervasive barriers to inclusive and efficient regional food markets that exist, an ambitious framework is needed that embraces all of Africa's vast territory from its isolated interior to the sea. Initiated by Nelson Mandela when he was president of South Africa, the Development Corridors are a comprehensive system that touches every country in Africa, potentially linking them together through stronger infrastructure and better policies connecting rural and urban communities to create functioning regional market systems and build opportunities across economic sectors and sovereign states. The Development Corridors not only enhance the ability of countries to trade regionally and internationally, they also present a way to equitably spread the benefits of trade, including greater access to economic

Unlocking Africa's untapped potential for expanded trade and equitable development will depend upon improving both hard and soft infrastructure.

¹⁶ World Bank, *World Development Report 2009: Reshaping Economic Geography*, Washington, DC, 2009.

¹⁷ Vivien Foster & Cecilia Briceño-Garmendia, PowerPoint presentation based on Africa's Infrastructure: A Time For Transformation, World Bank, 2009. Presented March 2010.

opportunities and food, harnessing trade's potential as a lever of broad-based development.

The Vision for an Economically Integrated Africa

From the roads of ancient Rome to the 19th century canals and railways of the United Kingdom and the United States, development tends to happen along corridors.¹⁸ The Tennessee Valley Authority is a particularly good example of a “Development Corridor”: a public-private partnership that was established to bring electricity, navigation, investment in fertilizer production, and economic development to a region of the United States hit particularly hard by the Great Depression.

Corridors are also natural markets and trade routes for all products, including food. Since ancient times, trade has taken place along linear corridors.¹⁹ One of the most significant trade corridors, the ancient Silk Road that covered 4,000 miles and connected China, India, the Middle East, and Central Asia to markets in the Mediterranean and Europe, is once again being developed. And in India, plans are afoot for a massive new \$90 billion industrial corridor — including nine special industrial zones, power systems, and new ports and airports linked to a high-speed freight line — that will stretch from Delhi to Mumbai, encompassing a region that contains one-seventh of the country's population.²⁰

Nelson Mandela's vision for economic growth and security in sub-Saharan Africa hinged upon economic policies shared across regions, greater collaboration between business and government, and more efficient transportation between Africa's vast interior and maritime trading lanes of the sea. Shortly after he became president of South Africa in 1994, Mandela charged his staff at the Department of Trade and Industry (DTI), many of whom fought alongside him in the struggle against apartheid, with creating a way to implement his vision. The department created the concept of “African Development Corridors,” which are referred

¹⁸ Peter Hall, “World Cities, Mega-Cities, and Global Mega-City-Regions,” 2004 Globalization and World Cities (GaWC) Annual Lecture, Loughborough University: January 2004.

¹⁹ John Arnold, “Best Practices in Management of International Trade Corridors,” The World Bank Group, Washington, D.C., December 2006.

²⁰ Bruce Stokes, “Failure to Launch,” *National Journal*, February 12, 2011.

to by various titles in the literature and were intended to generate a “new African industrial revolution” by turning infrastructure around natural resources into regional “economic ecosystems” connecting farmers and other businesses to vibrant markets.²¹ As envisioned, the Development Corridors would generate employment, enhance community welfare, and increase economic development and security.

Development Corridors would generate employment, enhance community welfare, and increase economic development and security.

At the heart of the motivation for the Development Corridors was the recognition that Africa’s rudimentary transportation infrastructure is preventing African entrepreneurs from benefitting — as either sellers or buyers — from regional and global markets, ultimately keeping millions of Africans locked in poverty. Mandela’s vision for economic growth and security in sub-Saharan Africa hinged on a regional approach to all aspects of governance, including shared economic policies. Yet he understood that African nations would never function peacefully and provide freedom to their people through harmonized policies to promote the movement of people, goods, and services across borders if there were no way to tap into its economic potential as a uniting force between rural and urban areas within countries and between countries themselves.

Mandela was especially concerned that Africa’s vast numbers of small — mostly subsistence — farmers be included in value chains and benefit from regional development strategies. Accordingly, the original objective of the Development Corridors was not just to build stronger trade and transport routes for commercial use but simultaneously to bring deep, sustainable development to Africa’s regions and farmers. This was to occur through public-private partnerships that would build the secondary and tertiary infrastructure needed to open up the corridors’ surrounding rural areas for agribusinesses and other small and medium-sized enterprises (SMEs) and create better access to urban, regional, and global markets for farmers and other rural businesses. The combination of public and private investment through which lucrative mining concessions could support infrastructure that

²¹ Rachel Tate “Can Development Corridors Now Produce Sustainable Domestic Outcomes in Mozambique?” BISA Conference Paper, April 25-27, 2011.

The original objective of the Development Corridors was not just to build stronger trade and transport routes for commercial use but simultaneously to bring deep, sustainable development to Africa's regions and farmers.

could also benefit agriculture — otherwise unlikely to ever be able to carry the infrastructure costs — is one of the key elements of a spatial development initiative (SDI). Its premise is relatively simple: use the existing but underperforming infrastructure connecting mines to ports to build out a comprehensive market system that connects rural areas to cities and farmers to commercial systems.

Leveraging public support and private sector investment, Africa's initial trade and transport routes would be turned into Development Corridors by using anchor mining and infrastructure projects to help

attract additional investment capital, and, as the corridors grow, boost economic growth, diversify economies, expand exports and foreign exchange, increase skills and technology transfer, and create jobs and boost local incomes.²² This process of geographic consolidation of development initiatives around market-driven business opportunities is referred to as “densification,” which means enhancing the development benefits through both backward and forward linkages to improve supply chains, facilitating the ability of SMEs to provide more goods and services locally, and linking agricultural development to other investment.²³ Aligning public and private investment around a market-based development plan will amplify the broad benefits for farmers and other entrepreneurs of turning transportation routes into Development Corridors.

Building on the Corridors

At first, both politics and lack of private sector interest in agriculture limited the possibilities for realizing Mandela's vision. Within Africa, leadership was not yet ready to fully embrace a regional approach, so the Regional Economic Communities

²² Dave Perkins and Glen Robbins “The Contribution to Local Enterprise Development of Infrastructure for Commodity Extraction Projects: Tanzania's Central Corridor and Mozambique's Zambezi Valley,” Making the Most of Commodities Programme (MMCP) Discussion Paper No. 9 March 2011.

²³ Perkins and Robbins (2011).

(RECs) and the African Union took on regional integration in a piecemeal fashion, which limited early development of the corridors. Furthermore, while the corridors needed business to thrive (as experience with successful corridors in Southern Africa demonstrated), business was mainly interested in resource extraction and other industrial development but not in agriculture. At that time, there wasn't much money to be made from agriculture, because there wasn't much demand for the food Africa was producing.

This lack of attention to agriculture has been reflected in the attitudes and resource allocation of the national governments along the corridors, whose officials in many cases not only fail to help create opportunities for farmers but also pass laws that slow the permitting processes and subject farmers to many new fees and taxes. There has also been a problem with the national governments' commitments to building and maintaining the secondary roads and the farm-to-market roads essential to connect more remote producers. Inefficiencies such as unnecessary checkpoints and weigh stations tend to keep agribusinesses and other companies that do not own anchor investments out of the corridors.

Things are changing, however, and agriculture is becoming part of the focus once again. Increased global demand for food and for Africa's natural resources — both agricultural and mineral — represents a shift in economic fundamentals and a major opportunity. The impacts of climate change on Africa will also raise the premium on distribution and transportation systems capable of moving food in and out and necessitate the reclamation of farmed-out soils which, in turn, will require technology transfer, irrigation, and increased use of inputs such as fertilizer, preferably via the development of a homegrown African fertilizer industry. Nonagricultural investment in areas such as mining will provide additional sources of demand; mining operations in the African interior will need to be supplied with food, and this could be produced by local farmers rather than imported. Such semi-guaranteed markets could, in turn, provide an opportunity to upgrade current farm practices and increase productivity in advance of entry into more competitive regional and global markets.

The corridors are now receiving increasing support among broad African leadership, including the African Union (AU), the RECs, and the AU's Comprehensive African Agriculture Development Programme (CAADP) and New Partnership for Africa's Development (NEPAD) as well as from international institutions, including the United Nations' Economic Commission for Africa and a number of donors, most notably the United Kingdom's Department for International Development (DFID). With Africa-wide and international support, a number of corridors now exist or are in varying stages of development. NEPAD officially works with 26 priority corridors, and a number of others have sprung up as well. The South Africans, using the SDI approach, have provided help with management to several successful corridors, starting with the Maputo and Walvis Bay Corridors in Southern Africa and now extending to additional corridors. Agricultural growth corridors with strong private sector participation are also being developed in Eastern and Southern Africa.

The corridors approach presents a promising route for navigating some of the complex and often overlapping political aspects of regional integration that have held back past efforts.

While realizing Mandela's vision and building an Africa-wide market will rely on the support and participation of African institutions, including the RECs, the corridors approach presents a promising route for navigating some of the complex and often overlapping political aspects of regional integration that have held back past efforts. Because the Development Corridors are at their heart physical — and not political — markets, they present a new avenue for pushing forward the regional economic development that can link the

food deficit parts of the continent with those that can help supply necessary food and inputs. The stronger African economies and more developed regions — including Northern Africa — will have a particularly critical role to play in unlocking the potential of the corridors. Doing so, however, will depend upon recognizing and prioritizing potential opportunities and addressing the hard and soft infrastructure barriers that are preventing regional markets from growing.

Regional Markets, Infrastructure Challenges, and Policy Change

An essential component of the Development Corridors concept is significant investment in roads, railways, processing facilities, warehouses, energy infrastructure, and ports in order to reduce transportation times and costs and stimulate successive rounds of investment, turning the Development Corridors into engines of regional growth and development. Perhaps even more critical is the ability of the corridors to address soft infrastructure challenges and leverage policy reform to develop and implement sound and transparent laws and regulations governing all aspects of business and trade. Regional governance and implementation capacity will also need to be boosted to stimulate market growth, expand economic opportunities, and help lessen Africa's growing dependence on food imports.

Hard Infrastructure

The barriers to increased trade and development in Africa's regional markets are not insignificant. Africa's transport costs are the highest in world, at well over twice the level of other developing regions.²⁴ Costs vary by region and depend upon whether a country is landlocked or has port access. Transport costs for poor, landlocked countries are up to four times as high as those in developed countries.²⁵ These high costs result from a combination of hard and soft infrastructure challenges, many stemming from neighboring countries,²⁶ with poor infrastructure accounting for up to 60 percent of the cost of doing business in landlocked countries.²⁷ The cost of transporting goods in Eastern Africa is 30 percent higher than in South

Africa's transport costs are the highest in world, at well over twice the level of other developing regions.

²⁴ "Trade Facilitation to Promote Intra-African Trade," Committee on Regional Cooperation and Integration, Addis Ababa, Ethiopia, March 24-25, 2005.

²⁵ Transport costs can account for up to one-third of GDP and can represent much of the export value for many landlocked countries. In Rwanda, for example, transport costs account for up to 40 percent of the value of coffee exports. "Land Transport for Exports: The Effects of Cost, Time, and Uncertainty in sub-Saharan Africa," Washington, DC: U.S. International Trade Commission, 2009.

²⁶ Paul Collier, *The Bottom Billion*, Oxford University Press 2007.

²⁷ Nuno Limao and Anthony Venables, "Infrastructure, Geographical Disadvantage and Transport Costs," Mimeo, World Bank, Washington, and Columbia University, New York (2000).

Africa — and 60 to 70 percent higher than in the United States — reducing growth by one percent annually.²⁸

These problems are most acutely felt in agriculture, as transport costs are relatively higher for many farm products, including cotton, fruits, and vegetables. Delays and uncertainty in transportation can lead to spoilage, additional warehousing or port payments, along with the need to maintain extra inventory. Weak storage and distribution infrastructure further add to the costs of agricultural trade.

It is estimated that every ten percent increase in transport costs reduces trade by 20 percent.

High transport costs limit Africa's ability to trade locally, regionally, and globally. It is estimated that every ten percent increase in transport costs reduces trade by 20 percent.²⁹ Better infrastructure and policies will reduce transportation times and costs and stimulate investment and trade. And, once again,

what a country's neighbors do, particularly if it is landlocked, will be a determining factor in opening up or limiting economic possibilities.

Focusing on Africa's roads alone would have a significant impact. The continent lacks all-weather roads, with fewer than 30 percent of roads paved and the majority of roads covered in either gravel or dirt. And much of the existing road network is in disrepair.³⁰ An estimated investment of \$32 billion is needed to upgrade Africa's roads. If this investment were to be made, however, the results would be exponential, generating over \$250 billion in trade over 15 years.³¹ Further, paving all of Africa's inter-state roads could more than triple existing trade.³²

Africa's railroads also need investment. Along the two main corridors in the East African Community (EAC), the Central

²⁸ Perkins and Robbins (2011).

²⁹ Limao and Venables (2000).

³⁰ In 1999, 34 percent of the paved roads and 68 percent of the unpaved roads in the COMESA region were in poor condition. *Supra*, Note 19.

³¹ Van Dijk, (2011).

³² Souleymane Coulibaly, "Landlockness, Transit, and Road Quality in West Africa," HEC University of Lausanne and TEAM, University of Paris, November 17, 2004.

Corridor³³ and Northern Corridor,³⁴ railroad coverage is spotty and cannot be relied upon for most transportation, driving up the cost of transport by road. Repeating a problem of early industrializing England, the Northern Corridor still has three separate railway gauges, making railway transport particularly difficult and costly.

In addition to roads and railways, Africa's ports lack capacity, and opportunities for water transport are underdeveloped.³⁵ The port of Mombasa, one of East Africa's major ports and the anchor port of the Northern Corridor, takes up to two weeks to clear.³⁶

Finally, electricity coverage is low throughout sub-Saharan Africa, with coverage as a percentage of population at only 16 percent as compared with 41 percent in other developing regions.³⁷

Soft Infrastructure

While national governments are addressing some of the physical infrastructure issues surrounding the corridors, soft infrastructure challenges — better laws, regulations, certification systems, and other government policies and programs relating to import and export, setting up a business, making better quality and higher yielding seeds available, meeting quality and food safety standards, etc. — require much greater attention and are likely to have the greatest impact on regional trade and development of the corridors.³⁸

Soft infrastructure challenges require much greater attention and are likely to have the greatest impact on regional trade and development of the corridors.

³³ The Central Corridor connects the port of Dar es Saalam to the Great Lakes region, extending into Rwanda, Burundi, the Democratic Republic of Congo, and Uganda.

³⁴ The Northern Corridor connects landlocked Eastern and Central Africa, namely Burundi, the Democratic Republic of Congo, Rwanda (by road), and Uganda (by road and rail), to the port of Mombasa in Kenya, with links into northern Tanzania, South Sudan, and Ethiopia as well.

³⁵ World Bank, "Non-Tariff Measures on Goods Trade in the East African Community," Synthesis Report Prepared for the East African Community, September 29, 2008.

³⁶ *Id.*

³⁷ UNECA, Economic Report on Africa "Developing African Agriculture Through Regional Value Chains," Chapter 4, "Challenges to Agricultural Development in Africa," 2009.

³⁸ *Supra*, Note 30.

It takes longer and costs more to both export and import goods in Africa than anywhere else in the world.

Policy and regulation are major challenges for most corridors, and much attention has focused so far on border crossing procedures.³⁹ Experts estimate that only 25 percent of the delays on the corridors are due to hard infrastructure, while 75 percent of the delays are caused by soft infrastructure challenges and poor trade facilitation.⁴⁰ While focusing on trade facilitation alone will not generate sustainable development benefits through the corridors,⁴¹ trade facilitation is critical to movement along the corridors.

The World Bank estimates that it takes longer and costs more to both export and import goods in Africa than anywhere else in the world, with more documents and duplicative paperwork required and multiple, overlapping policies and agencies involved.⁴² Each day of customs delay reduces export volumes by 1 percent, on average.⁴³ Landlocked countries experience trade transaction costs that are more than double those in other developing countries and more than triple those in developed countries.⁴⁴

Once again, these burdens weigh most heavily on the agricultural sector.⁴⁵ Numerous checkpoints along transport routes, which connect landlocked countries to ports, add to transport delays,

³⁹ Arnold, (2006).

⁴⁰ LM Harmon, B Simataa, A van der Merwe “Implementing Facilitation on Trade and Transport Corridors,” Proceedings of the 28th Southern African Transport Conference (SATC 2009), Document Transformation Technologies, Pretoria, South Africa, July 6-9, 2009.

⁴¹ Productivity enhancement, trade development, and the development of secondary feeder roads to facilitate densification are critical to SDIs and Development Corridors. Thomas (2009).

⁴² Supra, Note 30.

⁴³ Simeon Djankov, Caroline Freund, Cong Pham, “Time Costs as a Barrier to Trade,” World Bank Policy Research Working Paper 3909 (2009).

⁴⁴ Gael Rabelland, Jean-Francois Marteau, Charles Kunaka, Jean-Kizito Kabanguka, Oliver Hartmann, “Lessons of Corridor Performance Measurement,” Sub-Saharan Africa Transport Policy Program, Discussion Paper no. 7 Regional Integration and Transport – RIT Series, May 2008.

⁴⁵ Weak infrastructure and intra-regional trade barriers particularly have an impact on agricultural trade, as do low technology, poor skills, high internal taxes, continued dependence on a small number of commodities, high transport costs, the spread of HIV/AIDS, and pricing and marketing policies that penalize smallholder farmers. Todd Moss and Alicia Bannon, “Africa and the Battle over Agricultural Protectionism,” Washington, DC: Center for Global Development, 2009.

running up costs and hampering trade.⁴⁶ An additional day's delay due to transport and customs issues can cause exports of time-sensitive agricultural goods to decrease by 7 percent.

Many corridors, again critically but sometimes too narrowly, focus a significant amount of attention on trade facilitation, including the quality and competitiveness of transport and logistics services, the capacity and condition of public infrastructure, and regulation of transport services along the corridors.⁴⁷ Some corridors have succeeded in improving customs and transport policies, including through customs automation and one-stop border posts. For example, the Maputo Development Corridor⁴⁸ and Trans-Kalahari Corridor,⁴⁹ both of which are discussed in greater detail below, have succeeded in simplifying cross-border and customs procedures and significantly reducing delays at the border.⁵⁰ Another innovative approach to improve customs and transport is to move as many of these functions away from the border as possible.⁵¹

Other corridor efforts for improving trade facilitation have met with mixed success. Both the Central and Northern Corridors continue to experience long transit times and high costs, and both have had relatively slow growth despite the fact that they are essential regional trade routes.⁵² Multiple weighbridges exist along the Northern Corridor, and up to 27 police controls have been reported between the Mombasa port and the Ugandan border.⁵³ The Northern Corridor has been effective in driving

⁴⁶ While the costs of transport delays are significant, the benefits of reducing transport times can be immediate and transformative. Mali and Senegal signed a border cooperation agreement that reduced the number of checkpoints from twenty-five to four, and transport time quickly went from seven to ten days to just one or two. "Doing Business in Landlocked Economies," Washington, DC: World Bank Group, 2009.

⁴⁷ Arnold (2006).

⁴⁸ The Maputo Corridor connects South Africa's Gauteng industrial center with the Maputo port in Mozambique, linking to Swaziland, Botswana, and Zimbabwe along the way.

⁴⁹ The Trans-Kalahari Corridor is one of the three corridors that make up the Walvis Bay Corridor. It connects Johannesburg and Pretoria through Botswana and Namibia, linking to Zambia and Zimbabwe as well.

⁵⁰ See, e.g., Arnold (2006).

⁵¹ Arnold (2006).

⁵² Arnold (2006).

⁵³ *Supra*, Note 19.

implementation of a regional transit regime at the national level, however, helped by its transition to more fully integrate the private sector.⁵⁴

In West Africa, steps are being taken to remove customs check points, particularly in Ghana through legislation to reduce the number of authorized check points between the port of Tema and the border with Burkina Faso.⁵⁵ Also in West Africa, a coalition of companies and international institutions, including Unilever and the World Bank, has launched a project to improve customs administration in the Economic Community of West African States (ECOWAS) region along the Abidjan-Lagos Corridor,⁵⁶ with the goal of reducing customs and transport barriers.⁵⁷ The North-South Corridor has improved movement of goods along the corridor through both development of trade-related infrastructure, including roads, bridges, and ports, and through better trade facilitation measures, including one-stop border posts and enhanced capacity in trucking and shipping agencies.⁵⁸

Nontariff barriers are much more significant than tariff barriers, although some tariff barriers continue to exist, particularly in agriculture. For example, Tanzania has almost completely liberalized trade in agricultural goods with the East African Community (EAC) but continues to maintain restrictive tariffs on almost all food products from the Southern African Development Community (SADC). Ghana also maintains relatively high tariffs on dairy, maize, rice, and palm oil.⁵⁹ SADC has restrictions on significant products like sugar, which are scheduled to phase out within the next few years. Ethiopia also maintains high tariffs on agricultural trade within the region and with the rest of the world. On the other hand, Mozambique and Rwanda have relatively low

⁵⁴ Adzigbey, Kunaka and Mitiku (2007).

⁵⁵ Rabelland, Marteau, Kunaka, Kabanguka, and Hartmann (2008)

⁵⁶ The Abidjan-Lagos Corridor connects Côte d'Ivoire to Nigeria and passes through Ghana, Togo, and Benin.

⁵⁷ It is currently more expensive to move a product from Abidjan to Lagos than to import the same product from China or India. See Business Action for Africa, Business Partnerships for Development in Africa, December 2010.

⁵⁸ The North-South Corridor has been supported by donors including DFID, the U.S. Agency for International Development (USAID) and the Japan International Cooperation Agency (JICA).

⁵⁹ Van Dijk (2011).

agricultural tariffs.⁶⁰ Removing these barriers to trade within Africa will be critical to both economic development and food security.

Of the main African regional economic communities, agricultural and food trade has increased within the Common Market for Eastern and Southern Africa (COMESA) and SADC, remained relatively stable in the EAC and decreased within ECOWAS.⁶¹ It is notable that some of the early SDI corridors have been promoted in East and Southern Africa, the same regions that have shown growth in agriculture and food.

In addition to customs, nontariff barriers remain in regulatory and certification regimes, particularly with respect to food safety and certification of seeds and other agricultural products. Governments often apply these sanitary and phytosanitary (SPS) standards arbitrarily or lack the technical capacity to implement laws consistently and in a business-friendly way. Numerous standards also exist, creating a complicated web for agribusinesses to navigate. Not only must agricultural products conform to very detailed SPS standards for specific products and type of industry (e.g. separate rules apply for organic or fair trade production), these standards vary from country to country and are supplemented by separate standards imposed by the private sector. Additional standards to ensure product safety, or technical barriers to trade (TBT), are imposed as well.⁶² As commodities are transformed into higher value-added products, many standards become more exacting, and adequate transport and storage become even more critical and expensive. Like other policy issues, food safety and product standards are increasingly being dealt with on a regional level, and both policy reform and capacity building are necessary to make regional SPS systems work to the advantage of agricultural development. Within African regions, countries do not tend to recognize the inspection processes and SPS regimes of neighboring

⁶⁰ Van Dijk (2011).

⁶¹ Van Dijk (2011).

⁶² For example, coffee exports to the European Union require compliance with complicated SPS and TBT measures (including labeling and packaging requirements), and individual member countries can impose different standards, as do different trading partners including the United States. United Nations Conference on Trade and Development, "Rwanda's Development-Driven Trade Policy Framework," New York and Geneva: 2010.

Markets are only as effective as the policies that create them, and open international markets could make a critical difference in improving African farmers' opportunities and livelihoods.

countries, despite regional trade agreements requiring this type of treatment.⁶³

Of course, soft infrastructure barriers do not only exist within Africa. International barriers exist and limit trade as well. Internationally, SPS standards can also be a significant barrier to growth in the African agricultural sector, due both to their complexity and the number of overlapping standards. With exceptions, while many of the actual European and U.S. food safety and animal and plant health requirements are not fundamentally different, U.S. and European regulators have imposed differing requirements for demonstrating

compliance with these rules.⁶⁴ This points to a needless lack of coherence between rules intended to achieve the same ends, which increases the burden of compliance for developing country exporters. While the science underpinning these rules is critical to food safety, in many cases, the processes for implementing the rules could be streamlined and made more transparent. SPS issues are just one example of international barriers to trade and agricultural development along the corridors. Others, including restrictive market access practices, are discussed in greater detail below. Markets are only as effective as the policies that create them, and open international markets could make a critical difference in improving African farmers' opportunities and livelihoods.

Early Corridor Success Stories: Maputo and Walvis Bay

Southern Africa now has several successful Development Corridors that can offer important lessons on which to build. The Maputo Development Corridor (MDC), the first SDI launched in the mid-

⁶³ For example, this is a particular problem in the EAC. See, e.g., supra, Note 30.

⁶⁴ For example, a recent study examining the SPS regimes in the United States and Europe for both green beans and shrimp (products commonly exported by developing countries) highlights unnecessary differences in U.S. and European approaches that complicate the export of these products, particularly for producers hoping to serve both markets. Currently, exporting horticultural products to the EU is relatively easy, while exporting seafood is more difficult; the reverse is true of the U.S. market. Linda R. Horton and Elisabethann Wright, "Reconciling Food Safety with Import Facilitation Objectives: Helping Developing Country Producers Meet U.S. and EU Food Requirements Through Transatlantic Cooperation," Washington, DC: International Food and Agricultural Trade Policy Council, 2008.

1990s by South Africa, Mozambique, and SADC to upgrade the existing transport corridor between Maputo and Johannesburg, provides a historical example of the staggering economic impact and success that can result from addressing hard and soft infrastructure challenges.

The MDC was designed to revitalize southern Mozambique's economy after years of civil war and bring benefits to South Africa in the wake of apartheid⁶⁵ by linking ports and airports with many industries, including iron and titanium mines, a steel plant, an aluminum smelter, a fertilizer complex, and tourist facilities.

The MDC set out to rehabilitate regional infrastructure, in cooperation with the private sector, maximize investment along the corridor, increase social development, and further policies that would promote participatory government.⁶⁶ The core initiative featured public-private partnerships that upgraded roads, rails, ports, electricity supply lines, border crossings, and airport facilities and thus greatly reduced transport and transiting costs. The Maputo Development Corridor also successfully addressed policy barriers, including measures at the border.

The MDC was launched with funding from the governments of South Africa and Mozambique, BHP Billiton, Mitsubishi, and the International Finance Corporation. Between 1996 and 2005, the MDC attracted over \$5 billion in private sector investment along the corridor, according to a UN estimate. This included a \$200 million hydroelectric project on the Zambezi River and the \$50 million development of a new tourism route from South Africa to Mozambique through Swaziland.

Overall, the MDC is regarded as a success, due in large part to high-level political support from both President Mandela and President Chissano of Mozambique, as well as focused private sector participation. Critics of the corridor note difficulties engaging and coordinating stakeholders in affected local communities and question the degree to which the MDC promoted community development, particularly in Mozambique where the

⁶⁵ Monty Roodt "The Impact of Regional Integration Initiatives and Investment in a Southern African Cross-Border Region: The Maputo Development Corridor," *African Sociological Review* 12, 1, 2008, pp. 88-102.

⁶⁶ Adzigbey, Kunaka, and Mitiku (2007).

capacity was lacking to fully coordinate and assess the implications of projects along the corridor.⁶⁷

Another largely successful SDI corridor initiative is the Walvis Bay Corridor, which consists of three trade routes, including the Trans-Kalahari Corridor, linking the port of Walvis Bay in Namibia to neighboring countries. Like the Maputo Development Corridor, the Walvis Bay Corridor has been particularly active, in part due to the strong involvement of the private sector.

There is a very real possibility of harnessing the new surge of resource-based investment in sub-Saharan Africa for agriculture-led growth and food security, making the Development Corridors approach timelier than ever.

Recently, corridor management on both the Central and Northern Corridors has expanded to include SDI involvement in an effort to create true Development Corridors with the goal, particularly along the Central Corridor, of unlocking the region's substantial agricultural potential.⁶⁸

The successes of the Maputo and Walvis Bay Corridors, while significant, have only provided a glimpse of the potential the corridors hold. The fundamentals are now right. There is a very real possibility of harnessing the new surge of resource-based investment in sub-Saharan Africa for agriculture-led growth and food security, making the Development Corridors approach timelier than ever. Doing this, however, will require learning from the lessons of the past in order to use the Development Corridors effectively as a fulcrum for a widespread transformation of African agriculture to promote greater food security and broad-based benefits.

Lessons Learned

Past experience has shown the corridors' potential to function as an organizing framework for both public and private infrastructure investors, which is particularly appealing in the context of Africa's

⁶⁷ Thomas (2009).

⁶⁸ Gold mining in Tanzania will be the Central Corridor's anchor investment. The Northern Corridor's Council of Ministers also mandated that it be transformed into a Development Corridor using SDI, and a new Northern Corridor Agreement was signed in 2007 to this end. See Perkins and Robbins (2011) and Adzigbey, Kunaka, Mitiku (2007).

history and geography. Much money has been wasted creating infrastructure without a sound economic justification: roads that did not connect markets to centers of production and ports in which the wrong equipment lies idle. The cumulative effect of this history is highlighted in the World Bank's World Development Report for 2009, which focuses on spatial development.⁶⁹ Bank economists analyzed the past 20 years of World Bank infrastructure investments, dividing the developing world into four regions, one of which is sub-Saharan Africa. They found that, in three of those regions, over 75 percent of the business infrastructure was in the "right" places to underpin increased economic growth. In sub-Saharan Africa, the figure was under 50 percent.

While it was successful in generating infrastructure investment, the Maputo Corridor underperformed in using infrastructure investment to generate broader-based welfare gains. Additionally, wrangling over budgets and cost sharing between customs unions and ports, arguments over the railway rate-structure and other problems resulted in slower progress than the "fast-track" that the Corridor's founders had originally envisioned. However, as business expectations and demands continued to grow, the pressure on government officials to move faster increased.

Leaving aside its limitations, the Maputo Corridor did demonstrate that the overall Development Corridor strategy, if further developed to include a broader range of stakeholders and if replicated throughout sub-Saharan Africa, could accelerate the adoption of regional policies and practices that would significantly improve the business climate, stimulate business efficiency, promote growth and productivity in agriculture, and reduce rural poverty. Experience also shows that successful densification will not happen automatically, especially when the anchor investments are in mining.

The Maputo Corridor did demonstrate that the overall Development Corridor strategy could accelerate the adoption of regional policies and practices that would significantly improve the business climate, stimulate business efficiency, promote growth and productivity in agriculture, and reduce rural poverty.

⁶⁹ World Bank, *World Development Report 2009: Reshaping Economic Geography*, Washington, DC, 2009.

The Development Corridors provide a viable means for overcoming some of the seemingly intractable problems of political will and governance that have bogged down previous efforts at regional integration and policy change in Africa.

The Development Corridors approach is only effective where there is true economic potential and untapped demand in the market. Private sector resources must be marshaled, either through public-private partnerships or direct investment, to unlock this potential and demonstrate the possibility of commercial returns. Public sector resources, always scarce, should be prioritized and focused. Finally, the benefits of economic growth must be extended to those who have been previously left out — including smallholder farmers, SMEs, and impoverished communities.⁷⁰

With the right support, governance, and participation, the Development Corridors provide a viable means for overcoming

some of the seemingly intractable problems of political will and governance that have bogged down previous efforts at regional integration and policy change in Africa. The Development Corridors are by definition economic markets that cut across borders and political alliances rather than being yet another set of political entities themselves. Their success will depend largely upon the ability of governments to target the hard and soft infrastructure constraints and policy challenges outlined above. Investors and donors will pay close attention to this factor in determining where to focus resources.

Regardless of whether policy change needs to happen at the local, national, regional, or international level, political will is perhaps the most critical factor. The Maputo Corridor was particularly successful due to active, high-level support by the heads of state involved. Sustained participation at this level, along with dedicated resources and staff and a willingness to expend political capital to ensure the cooperation of different levels of government and stakeholders with divergent interests are all critical to building successful Development Corridors.

⁷⁰ Rosalind Thomas, “Development Corridors and Spatial Development Initiatives in Africa,” January 2009.

In addition to the support of national governments, the RECs must be part of the process, and the Development Corridors can provide a necessary impetus to the RECs' work to achieve regional market development. While numerous regional agreements exist to remove market barriers, implementation of these agreements is weak and inconsistent, due both to limited political will and lack of technical capacity. Further, many countries are party to several different RECs, creating numerous, overlapping obligations. With strong participation by business focused around tangible economic opportunities and real demand, the Development Corridors can sometimes push forward regional reforms in a way that the RECs cannot.

A New Era of Opportunity

The Development Corridors could be a means to transcend Africa's political geography and vast expanse. With resource scarcity and the attraction of Africa's mineral wealth once again triggering investments in infrastructure in support of extractive industries, a new opportunity is presenting itself.⁷¹

Part of this new opportunity stems from the fact that the private sector is beginning to view agricultural investment differently. Investors are increasingly interested in investment in agriculture, previously viewed as offering lower returns and being prohibitively "risky," particularly if there are ways to mitigate risk through the right policies and the balance between public and private investment. This shift will help integrate agriculture more significantly in the Development Corridors, where substantial investment is needed in additional infrastructure, including secondary and tertiary roads to connect farmers to markets, railways, and better port facilities, along with agro-processing and storage facilities.⁷² This investment could piggyback onto public and private investments in infrastructure and onto new business activities stimulated by the Development Corridors.

⁷¹ Paul Collier, "The Coming Scramble for Africa's Resources Needs a New Rulebook," *Europe's World*, May 20, 2011.

⁷² The Commission for Africa estimates that between \$20-40 billion is needed to build and upgrade Africa's infrastructure networks, with an additional \$40 billion per year needed for upkeep. "Our Common Interest: The Report of the Commission for Africa," London: The Commission for Africa, March 2005.

These new dynamics around agriculture have also shifted focus to smallholder farmers in a way that is new in the history of the Development Corridors. When the Development Corridors were first tested, the only efforts to integrate smallholder farmers were on a project-by-project basis, but this proved much too slow to effectively capture the momentum behind anchor projects and related investments, and smallholder farmers were ultimately left behind. New ways of integrating smallholder farmers into commercial arrangements like contract farming and outgrower models — which is now the standard in a number of industries including, notably, sugar — were also not fully tested or understood.

As markets develop and the chances to reach more consumers increase, so must farmers' ability to produce more efficiently and to meet new market specifications. With increased demand in the market comes increased demand for market information and business services as well. Persuading companies to buy supplies locally, process more in-country, and even hire labor locally requires education and negotiation. The opportunities for business expansion and densification are greater if civil society organizations and like-minded businesses work together to promote greater transparency, improve the investment climate, reduce trade barriers, and, ultimately, focus government attention on removing other barriers to more diversified economic growth.

The corridors can also play a role in organizing donors to work together around a shared goal, each playing the role and taking on the job that they are meant to do to please their constituencies back home. After years of staying out of agriculture, donors are

As markets develop and the chances to reach more consumers increase, so must farmers' ability to produce more efficiently and to meet new market specifications.

directing their energy toward agriculture, now widely seen as the key to Africa's future. But increasing harvests without developing ways to store, transport, process, add value to, and market those harvests is both short-sighted and unsustainable. Using the corridors as a way to organize broad-based stakeholder demand and expectations could also go a long way toward realigning government priorities with the priorities of business development, including farmers and agri-processing.

It could also fill in the gaps left by a fragmented international system that has yet to create sufficient mechanisms to successfully guide and prioritize its infrastructure lending and agricultural support to underpin a holistic response to Africa's food crisis through more rapid development and growth. Without such a systemic approach, food production, marketing, and consumption on the continent will remain unsustainable, lacking viability when the donors depart, as has happened in Africa in the past.

The corridors could also demonstrate to Africans the benefits of more forward-looking policies in trade and investment and sound regulatory systems to promote food safety.

The corridors could also demonstrate to Africans the benefits of more forward-looking policies in trade and investment and sound regulatory systems to promote food safety. One of the lessons of the failure of the Doha Development Round of global trade talks at the World Trade Organization (WTO) is that without a viable development plan that links more liberal trade policies with reliable opportunities for economic growth and food security, trade liberalization will not garner the support required to override entrenched interests that have always blocked reform. One way to affect Africa's trade policies and productivity investments is to use concrete business opportunities within Africa to create more "demand driven" trade policies. These business opportunities can also be an action-forcing event to demonstrate that a better business climate, including investment and trade policies, would create more opportunity for more people, which in turn will lead to more prosperity and stability.

A Way Forward

Opening the corridors up for multiple uses requires new ways of thinking and acting. It will require cooperation not only among investors, businesses, farmers, entrepreneurs, and others, but also among foundations, civil society organizations, and the other aid and service providers working with them.

In 2007, a team organized by the William & Flora Hewlett Foundation⁷³ began to work on the Development Corridors as the best available way to bring more discipline to donor investment and policy in Africa in order to enhance agricultural productivity, trade and food security; promote new ways to fast forward agricultural development in Africa; develop a demand-driven approach to trade policy toward Africa; and, finally, develop closer working relationships with the private sector at the ground level.

Policy barriers can present a tangible risk to investors and restrict growth in the African agricultural sector, limiting the opportunities investors and farmers will pursue.

This effort grew into TransFarm Africa (TFA), an initiative that both increases investment in the “missing middle” of African agriculture and simultaneously effects meaningful policy change. TFA is based on the premise that, in order to sustainably develop, Africa’s agricultural sector needs both capital investment — in particular in agribusinesses that build and integrate the sector by exploring new opportunities, closing gaps in value chains and equitably connecting smallholder farmers into commercial systems — and the targeted removal of policy and market barriers that stand in the way of unlocking Africa’s agricultural potential. Increased investment and policy change are very closely linked, and one will not move forward without the other. Policy barriers can present a tangible risk to investors and restrict growth in the African agricultural sector, limiting the opportunities investors and farmers will pursue. They also directly affect the ability of farmers to stay in business, expand their operations, and innovate in socially beneficial ways, including working more closely with smallholders and addressing climate change.

TFA has focused its work around several specific corridors, namely the Beira Corridor in Mozambique and the Southern Agricultural Growth Corridor of Tanzania (SAGCOT). This experience, along with recommendations from other corridor participants and experts, has highlighted several critical areas that need to be addressed in order to generate sustainable development, food security, and vibrant markets along the corridors. They are,

⁷³ Including, in particular, the Partnership to Cut Hunger and Poverty in Africa, Technoserve, the World Wildlife Fund, and experts in agriculture, investment, and trade, including the author.

briefly, corridor governance, business participation, and the role of international donors and policies.

Corridor Governance

Not only are corridors natural routes for trade and development, they are also a natural framework around which to build mechanisms for balancing stakeholder interests and coordinating investment priorities and demand-driven policy change. In order to succeed, the Development Corridors will require the cooperation and support of many actors, including businesses of all sizes, national governments, regional entities, and international and multilateral governments, institutions, and donors. While no single model for corridor governance exists, the more transparent and well-governed the corridor, the greater its chances of long-term growth and success, as Maputo and Walvis Bay illustrated.

Thus far, even the most successful corridors have only been partial successes in terms of governance. Maputo is a good example of a public-private partnership that can coordinate among stakeholders to advance the various goals of the corridor. But, as noted above, it too did not successfully integrate all stakeholders or extend to agriculture.

Most corridors have different goals to advance⁷⁴ and a coordinating function is necessary. Many experts recommend that this be a simple function, while some suggest a slightly more involved governance structure that coordinates among government stakeholders and core constituencies in addition to maintaining a secretariat to coordinate the corridor's activities.⁷⁵ The public-private partnership model is becoming increasingly popular as the importance of involving business in all aspects of corridor governance becomes more widely accepted, but it, too, has its limitations.

⁷⁴ Different corridors have different and often disparate goals, including agricultural development, trade facilitation, and development. Several, including the Abidjan-Lagos Corridor — which is the busiest corridor in Western Africa, connecting the five countries of Côte d'Ivoire, Ghana, Togo, Benin, and Nigeria through the ports of Abidjan, Accra, Lome, Cotonou, and Lagos — and the Walvis Bay Corridor, address health concerns as well as economic priorities and place a high priority on addressing the transmission of HIV/AIDS along the corridor. Adzigbey, Kunaka, Mitiku (2007).

⁷⁵ Yao Adzigbey, Charles Kunaka, Tesfamichael Nahusenay Mitiku, Institutional Arrangements for Transport Corridor Management in Sub-Saharan Africa, Sub-Saharan Africa Transport Policy Program, SSATP Working Paper No. 86 October 2007.

Since none of the corridors thus far has sufficiently integrated agriculture, new systems of governing the corridors will be required in order to make them live up to their development potential. Multi-stakeholder coordination must include coordination with those who stand to benefit from the corridors but don't have significant political muscle (e.g. rural communities, farmers associations, SMEs, etc.). Additionally, the development aspects of the corridor — including a focus on agricultural development — will not materialize unless concerted attention is given to building this into the governance structure.

The South African SDI of the Department of Trade and Industry has been largely responsible for bringing a development focus to the corridors, but it too has had limitations as well as successes. Historically, spatial development programs have been used successfully elsewhere, with the greatest successes in urban areas because of the investment potential and population density. They have worked well if given enough resources to manage different stakeholders and when they have had clear policymaking authority with sufficient checks in place to make sure it was used well. London's Canary Wharf is one example. It has been very successful in creating wealth in part because the policymakers with responsibility for the initiative had broad authority to construct and implement development plans, while, at the same time, remained subject to strong oversight from public institutions that could intervene if they overstepped or were not fulfilling their mandate.⁷⁶ Further, the initiative had strong incentives to benchmark progress.

Thus far, the South Africans have provided virtually all of the “public governance” on the Southern African corridors through the SDI. It has a small, deeply committed and knowledgeable set of experts who typically are put on corridors as managers for two years and then rotated elsewhere as the corridor countries begin to take over. These corridor managers have no legal agreements and few of the resources that real development authorities have, but the SDI is currently the only “official” organizational entity whose first objective is the development success of the corridors.

While the SDI has, importantly, brought development concerns to the table and is increasingly becoming involved in corridor

⁷⁶ Based on conversations between Susan Sechler and Simon Zadek.

coordination, there are certain limitations inherent in SDI involvement that need to be addressed. For example, the SDI, even when in the role of corridor manager, does not have the necessary authority or political buy-in to intervene at national and regional levels where policies are made.⁷⁷ African SDI corridor managers also generally lack both resources and a strong institutional context from which they could initiate a process to consider and balance stakeholder concerns, which is a particularly important aspect of corridor governance. As noted above, other management authorities have at their disposal top notch assistance to make financial arrangements, structure concessions and other private sector relationships and investments, ensure the engineering integrity of the infrastructure, enforce planning requirements, and convene other agencies of government. In addition, the African SDI often has no control over the allocation of public agricultural, food security, and logistics investments necessary to, for example, build feeder roads to ensure that more remote villages and poorer populations are able to benefit from new access to markets. Finally, the SDI corridor managers for the most part lack business skills and relationships with businesses they trust to help guide them.

Applying these considerations to the question of better corridor governance, corridors could work much better as a focal point for food security and poverty alleviation initiatives if the right combination of interventions and partnerships could be created to make the corridors follow other successful regional development efforts. These have worked in large measure because of strong political backing, a good system of governance and the ability to time and package investment. This approach to the Development Corridors would help develop and strengthen regional governance as both a by-product and requirement of its success, but several elements are necessary to make this approach a success.

First, the appropriate mix of authorities, incentives, collaborations, and additional human capital need to be identified to make it possible for donors and investors to help develop stronger governance on the corridors. As Canary Wharf's success illustrates, it is necessary to push the political process and build in "good

⁷⁷ See "Non-Physical Barriers to Foreign Direct Investment and Trade for SADC Development Corridors," Draft Final Report, Prepared for SDI Programme by CSIR Transportek and Consilium Legis February 11, 2005.

conditionality,” i.e. incentives, benchmarks, and standards among the corridor stakeholders that would provide some of the authority and expertise with appropriate checks and balances to protect the less powerful stakeholder along the corridors.

Next, the question arises as to how public and stakeholder input should be organized, taking into account the public’s voice without putting unreasonable burdens on investors. This is especially important in the food security context since transparency and public scrutiny will be the most important lever against corruption and incompetence. Again, Canary Wharf is illustrative in that the policymakers tasked with the spatial development project had the broad authority to organize — and sometimes override — this input, but all the while remaining subject to checks on that authority to make sure it is not abused.

Making the corridors work for agriculture will require including the voices of all types of farmers as well as a way to assess and prioritize demand.

Making the corridors work for agriculture will require including the voices of all types of farmers as well as a way to assess and prioritize demand. A transparent and accessible process that builds stakeholder participation into the conversation from the very beginning is critical. This means providing a space to exchange information, work out conflicts, and build connections between producers and the businesses that will ultimately buy, process, and transport their products along the corridor.

As Maputo and Walvis Bay illustrate, the private sector is absolutely critical to the success of any corridors initiative, but it cannot be the primary organizer of stakeholder participation or corridor governance if broader goals are to be served. The question remains of how to secure buy-in at the very highest levels of government without usurping a role that should be played by others. The question of engaging business participation and increasing political will and ensuring government buy-in is addressed below, along with an innovative approach to push this process through demand-driven policy interventions.

To date, the most significant efforts to organize the corridors around agriculture by an outside entity have been the Southern Agriculture Growth Corridor of Tanzania (SAGCOT) that

extends from the port of Dar es Salaam into Zambia and the Beira Agricultural Growth Corridor (BAGC) in Mozambique with connection into Zambia as well. The private sector is very active and, along with the World Economic Forum (WEF), is driving activity and coordination on both corridors. Critically, the SAGCOT has support from the Tanzanian Government at the presidential level. So far, both corridors have struggled with the issue of how to engage agricultural stakeholders more broadly, and both are still searching for the right governance structure.

TransFarm Africa is an active participant on both of these corridors, and the challenge will be to find the right balance of public and private organization on the corridors that can bring in agriculture in an equitable way. In the case of SAGCOT, the backing of the Tanzanian president is significant, but now that additional resources are going into the corridor, the governance and coordination challenges are becoming more acute.

On the Beira Corridor, more concerted political support will be needed in order for the corridor to be a success. Several concrete policy obstacles have surfaced that threaten to block significant investment on the corridor. If these barriers are not addressed, the overall success of this corridor will be limited.

Finally, the other significant question that needs to be thought through and answered on corridor governance is the role of external state investors, especially, but not limited to, China. The Chinese are playing a huge role, much of it positive, in development in some corridors, but there has been only limited effort on the part of the United States to engage them in Africa. Overall, Chinese investment dwarfs that of the United States, and, going forward, conversations around the Development Corridors cannot be complete without integrating their role.

Private Sector Leadership and Demand-Driven Policy Change

Bringing business to the table — and ensuring that emerging opportunities in agriculture have a seat at the table with more-established

The other significant question that needs to be thought through and answered on corridor governance is the role of external state investors, especially, but not limited to, China.

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business — will be critical in pushing for the right policies to support Development Corridors. Business has been the engine of development in all economically developed nations, but true development that benefits the poorest relies on connections between the poor and business opportunities that will have an impact on them. Without a reliable way to make these connections, farmers and other small businesses cannot gain from the opportunities that are being created in more densely populated areas.

The experiences of the Maputo and Walvis Bay Corridors have shown clearly that the corridors simply cannot work without significant business involvement. Ensuring sustained, broad, and equitable business participation, however, is a challenge that must be addressed. Going forward, it will be important to change how businesses relate both to other stakeholders on the corridor and to each other.

Business interest on the corridors can be an irreplaceable driver of political will. As better models for corridor governance are tested that address the issues outlined above, some mechanism that ensures better interaction between business and government — with government responsive to the needs of businesses large and small — will be important. Business also needs to be brought to table in a competitive way, with a process on each of the corridors to ensure this and bring in the part of the business sector that is not well represented, namely smaller businesses and SMEs.

Viable Development Corridors will need a consistent, transparent system for addressing and removing specific market barriers along the corridors, along with methods of mitigating risk to encourage the right kinds of partnership and corridor arrangements in support of broader development.⁷⁸ Business will be a necessary force to generate policy change, and policies should be market-led and “demand-driven,” i.e., linked to specific economic opportunities and the barriers that stand in their way.

⁷⁸ Perkins and Robbins (2011).

TransFarm Africa is developing and testing a demand-driven approach to policy that has direct application on the corridors. TFA's policy component, the "Removing the Barriers" program, identifies and addresses the real and practical challenges in the agricultural sector, many of which are often beyond the immediate control of the businesses affected by them. In every case, TransFarm Africa is guided by a "demand-driven" approach to policy change that starts with the very specific on-the-ground needs faced by actual agribusinesses.

This model has been tested in Tanzania with TFA's investment in Mtanga Farms Limited, a mixed farming operation near the town of Iringa in the highlands of southern Tanzania.⁷⁹ Potatoes are a fairly popular crop in Tanzania, especially among women growing them to feed their families. They can be hearty and nutritious, but — especially in tropical climates — are prone to viruses, fungus, and various pests, some of which are carried from one generation to the next in the planting material. This hurts performance and dramatically reduces yields. Because their yields are so low, Tanzania's 150,000 smallholder potato producers could not keep up with booming demand; trucks filled with potatoes arrived daily from South Africa and went back empty. Seeing this opportunity, the entrepreneurs, farmers and investors who own and manage Mtanga Farms Limited identified clean stock being used successfully by farmers in neighboring Kenya and attempted to import a commercial quantity to begin supplying the Tanzanian market. Tanzanian authorities told them that the importation was illegal unless they were willing to conduct extensive field trials, which would take years.

The TFA team, comprised of agricultural, trade, and investment experts, worked with Mtanga to identify and address each specific barrier encountered. After numerous bureaucratic hoops — some of them generated on the Kenyan side — officials allowed the seed potatoes from Nairobi to enter the country legally and agreed that Mtanga could shorten its field trials from five seasons to just one. Results from the first year's trial were beyond what they had hoped

⁷⁹ See TransFarm Africa, *Removing the Barriers to African Farm Prosperity: Combining Investment and Policy to Establish a Seed Potato Industry in the Iringa Highlands of Tanzania — The Case of Mtanga Farms*, May 2011, www.aspeninstitute.org/sites/default/files/content/images/ghd/Mtanga_May_9_2011.pdf.

for: 40-50 tons per hectare, ten times the national average. From the experiences of successfully removing the barriers in the Mtanga case, TFA is now beginning a regional seed registration and transfer harmonization effort that will benefit the whole East African region and could eventually be replicated in other parts of Africa.

Within sub-Saharan Africa, the corridors are increasingly helping to organize a more empowered and diverse business class to push for the type of policy change needed to realize new business opportunities and expand those that currently exist. Successful Development Corridors will encourage the development of a diverse productive structure within the African agricultural sector, including policies that support value-added processing and manufacturing. They will also leverage the strengths of the private sector, governments, the RECs, and other stakeholders to best allocate resources, address market constraints, make possible unrealized opportunities and enhance farmers' connection to commercial systems and capacity.

Donor Policies and Interventions

The Development Corridors also present a much-needed framework around which to focus and prioritize international donor policies and interventions.⁸⁰ International efforts to increase trade with Africa and achieve and sustain greater food security have fallen short for numerous reasons. But perhaps the most enduring is the lack of attention to building efficient regional systems to move people, goods, services, and information from Africa's vast countryside to cities and coastal areas and across borders where there are markets and opportunities for business.

Where donor efforts on corridors have helped to fund some infrastructure investment and address certain policy barriers — e.g. lowering customs barriers — they have been less successful in stimulating the development of Africa's agriculture and food systems. As conceived, the Development Corridors strategy anticipated functional and transparent public-private partnerships that would build the secondary and tertiary infrastructure needed

⁸⁰ The Central, Northern, and Abidjan-Lagos Corridors, among others, highlight the importance of donors in encouraging multi-state corridors when countries might be initially reluctant to act before the regional benefits become apparent. Adzigbey, Kunaka, Mitiku (2007).

to open up the corridors' surrounding rural areas for agribusinesses and other SMEs and create better access to urban, regional, and global markets for farmers and other rural businesses. In practice, corridor development has focused on large infrastructure and major anchor investments, leaving agriculture largely out of the planning. Unless connections to agriculture are planned, they do not happen, and agricultural stakeholders have begun to see the corridors as something that drains resources away from them, rather than something that provides them with opportunities. The systems to generate agricultural opportunities — as well as the systems to move food — are cross-border enterprises, requiring the right policies and a careful pairing of public and private investments that go far beyond the sometimes ad hoc and often country-focused reach of most national governments and the bilateral and multilateral donors.

In practice, corridor development has focused on large infrastructure and major anchor investments, leaving agriculture largely out of the planning.

While policy change within sub-Saharan Africa is critical to food security and sustainable economic growth, the right international policy tools are needed to encourage this change on the ground. The global attention to food security provides new hope to help put Africa on the path to sustainable economic growth and greater food security, but the window of opportunity provided by the L'Aquila agreement and individual donor efforts, including the U.S. Feed the Future program, will not remain open for long. An opportunity exists to channel international resources to help Africa build true Development Corridors, which would require both strategically using donor funds to promote emerging opportunities and addressing trade barriers.

At a recent meeting of the WTO General Council, Zambia's then Trade Minister Felix Mutati asked WTO members to make the Development Corridors part of international trade and development policy with sub-Saharan Africa. Responding to this challenge would make a significant difference in Africa's own efforts to build regional markets, increase economic opportunities, and improve food security. This will require a shift in how trade and development policies, which currently are often poorly

The time is right for new leadership on trade policy with Africa from the United States and other developed country trading partners.

coordinated and even inconsistent, are developed and applied. With the Doha Round no longer pulling significant international energy and resources, the time is right for new leadership on trade policy with Africa from the United States and other developed country trading partners.

First, a critical lens needs to be applied to current developed country trade policies with Africa. For example, despite U.S.

development attention to Africa, U.S. trade policy continues to restrict opportunities in key commodities such as sugar through a burdensome system of tariff-rate quotas.⁸¹ Not only is sugar an important source of export revenue, with strong international demand, it is central to the livelihoods of thousands of smallholder farmers who produce it through outgrower arrangements. As the European experience with lifting sugar quotas has shown, opening international trade in sugar could generate desperately needed jobs and regional growth in Southern and Eastern Africa in particular.⁸² Further complicating markets, not only is trade in sugar and other commodities like dairy restricted, but any products containing sugar and dairy are restricted as well, thwarting opportunities for value-added production. For example, one of West Africa's main crops, cocoa, is mainly exported in its raw form for value-added production into chocolate elsewhere.

The European Union's Economic Partnership Agreements (EPAs) are also problematic and have been found to limit rather than

⁸¹ The United States restricts opportunities to export sugar and other commodities through a burdensome system of tariff-rate quotas that make it either impossible or commercially unviable to access the U.S. market, often despite significant U.S. demand. The current U.S. tariff-rate quota system for sugar gives quota allotments based on trade flows between 1975-1981, when the sugar market was last relatively "open." Based on this measurement, countries with an exportable surplus of sugar like Zambia do not receive a quota share at all. Mozambique, which is also competitive in sugar, receives a small quota share, but with out-of-quota tariffs approaching 200 percent and the impact the tiny quota has on shipments (i.e. shipping such a small amount may not be feasible or commercially viable), this does not make much of a commercial difference.

⁸² As a direct result of Europe's announcement of its Everything But Arms (EBA) program, which would, over time, grant least developed countries duty-free, quota-free access to the European market, Mozambique's sugar trade with Europe went from zero in 2000 when EBA was announced, to over 130,000 metric tons in 2008, with steady increases each year. Investment and job creation quickly followed the announced change in trade policy, and South African-based investors have opened several new mills in Mozambique alone.

encourage future African regional trade, curtailing one of the most important avenues for growth. Many African countries have protested strongly against these agreements, stressing their inappropriateness given the underdeveloped nature of African regional markets and institutions. Despite such a strong reaction to the EPAs model, however, it holds particular appeal with developed country policymakers due to its reciprocal obligations. Regardless of whether trade preferences or more reciprocal arrangements are used, a new approach to developed country trade policies with Africa is badly needed.

This new approach on trade should have several elements, and TFA is convening a multi-stakeholder process to develop these further and integrate them into the corridors. It should recognize potential for growth in African agriculture and encourage new opportunities rather than locking in trade provisions that maintain a discriminatory status quo. Encouraging innovative opportunities in agriculture, like Mtanga Farms discussed above, should be the priority, and trade and development policies could be reoriented to help other such opportunities thrive. As Mtanga has shown, policy approaches must be specific and demand-driven rather than broad and aspirational if they are to make a difference.

The new approach should also make African regional market development a priority and not pit African regional communities against one another. In contrast to the new European trade policy with Africa, the U.S. African Growth and Opportunity Act actually treats the entire region largely the same, simplifying and encouraging opportunities for regional market growth. The case could and should be made for treating the region as a whole both in bilateral trade relationships between Africa and its trading partners and at the WTO.

Encouraging innovative opportunities in agriculture should be the priority, and trade and development policies could be reoriented to help other such opportunities thrive.

Conclusion

Africa can and must avoid an intractable food crisis and set out instead on a path to sustainable development. The Development Corridors are the way forward. Just as corridors spurred development in ancient Rome, industrializing Europe, and the United States in the 20th century, they hold great promise for agricultural growth, food security, and broad-based economic opportunity in Africa. The African Development Corridors present a market-focused framework for infrastructure development and policy change that transcends some of the complicated political geography. The business demand around corridor development has already been shown to be a powerful tool in addressing regional trade barriers that limit so much of the continent's economic potential and opening markets.

While the African corridors have shown some notable successes, they are not yet being fully utilized. The corridors will not realize their full potential unless the issue of governance is properly resolved and until, with participation from new, more creative actors, they find ways to bring in and balance the voices of diverse stakeholders, particularly in agriculture. International donors

The time is right for a new approach that will support rather than undermine development of Africa's regional markets and use trade policy to encourage the development of new innovative opportunities in agriculture rather than preserving an outdated status quo that does not work to Africa's advantage.

and policymakers also have a significant role to play in supporting the Development Corridors. Public funds to support the corridors are critical, but they need to be used strategically, leveraging private sector investment and being judiciously applied only where and when needed most. The right international trade and development policies are also critical, and the time is right for a new approach that will support rather than undermine development of Africa's regional markets and use trade policy to encourage the development of new innovative opportunities in agriculture rather than preserving an outdated status quo that does not work to Africa's advantage. With the right mix of governance, political will, and policy support, both within Africa and internationally, the Development Corridors really do have the

potential to spur regional market development and unlock the potential for a dynamic agricultural sector capable of delivering real food security on the African continent and beyond.

2. Synergies in the Solutions to Africa's Climate and Food Security Challenges

Timothy D. Searchinger

Africa forms the epicenter of the world's climate and food challenges. Already home to the world's worst hunger problems, with a rapidly rising population and flat grain yields, Africa greatly needs to boost its food production. Climate models generally agree that African agriculture will also bear the brunt of climate impacts through higher temperatures that depress crops and probably also through lower rainfall and increased droughts and variability that make farming more economically challenging. On the other side of the ledger, African agriculture generates a significant and growing share of world greenhouse gas emissions. By 2050, despite generating less than 0.2 percent of world GDP, African agriculture could generate 10 percent of the total greenhouse gases that the whole world is estimated to be able to emit without continuing to warm the planet. Clearing forest to expand agriculture in Africa also threatens to raise regional temperatures significantly even beyond those generated by higher greenhouse gases in the global atmosphere.

The challenge of providing more food while mitigating greenhouse gas emissions from African agriculture is severe, but a suite of measures known today can help address both challenges. Few of them are easy, institutionally or practically speaking, however, and to meet both challenges completely will require substantial research and a range of scientific advances. Yet the opportunities for synergies in solutions to the two challenges represent the most practical and economical pathways for making progress on both fronts.

Developed nations have pledged to provide \$100 billion for climate adaptation and mitigation activities in the developing world. These funds could legitimately support measures to boost agricultural productivity for both adaptation and mitigation purposes while at the same time improving food security. All nations have an interest

in working out the specific details of these synergies and putting them into practice.

The Effects of Poor Agricultural Performance on Hunger in Sub-Saharan Africa

Chronic hunger is not always primarily related to poor local agricultural production. Most of the world's hungry live in Asia, with the largest number in India, where agricultural production overall is robust. India is also integrated into world agricultural markets as both an importer and exporter. Although hunger in India will increase with rises in world food prices, and local production will have a disproportionate effect on local prices, hunger in much of Asia results primarily from extreme income inequalities.

In Africa, the broad consensus is that poor agricultural production plays a major role in explaining the extent and extremes of hunger.

In Africa, however, the broad consensus is that poor agricultural production plays a major role in explaining the extent and extremes of hunger. Sub-Saharan Africa's yields are the world's lowest, in many places generating grain yields less than one metric ton per hectare. It is also the only major region where yields have remained all but stagnant since 1960,⁸³ with many African countries experiencing absolute declines in production of staple crops.⁸⁴ As

a result, the region imports 25 percent of the grain it consumes.⁸⁵ The hunger gap — the difference between calorie needs and consumption — is far starker in Africa than elsewhere and, according to a 2006 study by the U.S. Department of Agriculture, accounted for 85 percent of the world's total calorie gap even though Africa has 44 percent of the world's hungry people.⁸⁶

In general, studies have found that lower food prices provide the bulk of the reductions in hunger and poverty from increased

⁸³ World Bank (2008), *Agriculture for Development* (New York), p. 15.

⁸⁴ World Bank, *op. cit.*, p. 95.

⁸⁵ Authors own calculations from FAOSTAT.

⁸⁶ S. Meade, S. Rosen, S. Shapouri, *Food Security Assessment, 2006*, GFA-18 Economic Research Service, USDA, Washington. According to other estimates, sub-Saharan Africa is home to roughly one-quarter of the world's hungry people. World Bank, *op. cit.* p. 94.

agricultural productivity. Because of poor transportation and local production, among other factors, food prices in some African countries are particularly high.⁸⁷ Poverty makes it difficult for people to purchase food during periods of low domestic production, exposing Africans to the vagaries of international aid. The drought-prone nature of African agriculture creates highly variable yields that exacerbate hunger. The heavy reliance on imports makes African countries exceptionally vulnerable to exchange rate fluctuations, changes in fuel transportation costs, and many of the other factors that drive up food prices. Recent evidence underscores this dependence: despite record highs in world food prices in the winter of 2010-2011, the Food and Agriculture Organization (FAO) reported in January 2011 that good yields in Africa were buffering food price impacts in sub-Saharan Africa at the time.⁸⁸ Any increases in agricultural production and productivity in Africa in general — not just among smallholder farmers — are likely to have important benefits by holding down food prices in Africa.

At the same time, smallholder farmers constitute a large proportion of the population in sub-Saharan Africa. Of the region's 800 million people in 2008, 63 percent — more than 500 million people — were rural, according to the World Bank.⁸⁹ In turn, a large majority of those rural and hungry depend on agricultural activities for their livelihoods, and the bulk of their production is for subsistence.⁹⁰ As urban areas currently offer an inadequate supply of alternative jobs, helping smallholder farmers in Africa to increase their food

The heavy reliance on imports makes African countries exceptionally vulnerable to exchange rate fluctuations, changes in fuel transportation costs, and many of the other factors that drive up food prices.

⁸⁷ For example, Angola's food prices are 175 percent of world average food prices. World Bank, 2005 International Price Comparison of Global Purchasing Power Parities and Real Expenditures, Table 2.

⁸⁸ UN FAO, Global Food Price Monitor (14 January 2011), http://www.fao.org/gjews/english/gfpm/GFPM_01_2011.pdf

⁸⁹ World Bank data can be found at <http://www.tradingeconomics.com/sub-saharan-africa/rural-population-wb-data.html>.

⁹⁰ J. Faures, G. Santini (eds) (2008), *Water and the Rural Poor: Interventions for Improving Livelihoods in sub-Saharan Africa* (FAO, Rome).

production is a path to economic growth and a critical part of the challenge of reducing hunger.

We can think of these different pathways by which agricultural improvements can reduce hunger as 1) a food price effect and 2) a reduced poverty or income effect. Sub-Saharan Africa is the primary place in the world where agricultural improvements can reduce hunger through both pathways.

The Effects of Climate Change on Agriculture in Sub-Saharan Africa

According to the consensus view, net worldwide effects of rising temperatures on food production are uncertain up to 2 degrees Celsius of change and could possibly balance out. Warmer weather and higher levels of carbon dioxide could expand cropping area and stimulate yields in northern latitudes — although drought in Russia in 2010 and increased scientific proof of the adverse effects of high temperatures cast doubt on these positive effects. Unfortunately, there is little disagreement with the IPCC's statement in 2007 that "agricultural production, including access to food, in many African countries is projected to be severely compromised... [and will] further adversely affect food security and exacerbate malnutrition."⁹¹

The reasons fall into several broad categories. One involves rainfall. Although climate models differ substantially, most predict that rainfall will decline overall in the southern part of sub-Saharan Africa with disagreements about the eastern and western regions.⁹² Second, of greater consensus, models predict that rainfall will be

⁹¹ Intergovernmental Panel on Climate Change (2007) *Climate Change 2007: Synthesis Report* (IPCC, Geneva). A review of studies since that date finds that they confirm the conclusion. C. Muller et al. (2011), *Climate change risks for African agriculture*, PNAS 108:4313-4315.

⁹² P.J.M. Cooper et al. (2008), "Coping better with current climate variability in the rain-fed farming systems of sub-Saharan Africa: An essential first step in adapting to climate change," *Agric. Ecosys. & Env.* 126:24-35; A.J. Challinor, et al. (2009), "Crops and climate change: progress, trends, and challenges in simulating impacts and informing adaptation." *J. Exp. Bot.* 60: 2775-2789; A. Challinor et al. (2007), "Assessing the vulnerability of food crop systems in Africa to climate change," *Climatic Change* 83:381-399; P.K. Thornton et al. (2011), "Africa and food systems in sub-Saharan Africa in a 4 C+ world," *Phil. Trans. of the Royal Society* 269:117-1136; H. Paeth, et al. (2008), "Regional climate change in tropical and northern Africa due to greenhouse forcing and land use change," *J. Climate* 22:114-132.

more variable, both within years and among years. These changes promise to decrease yields, but with a fair degree of uncertainty.

Third and most unfortunately, the models agree that the region will face significantly higher temperatures both on average and at peak periods, and the evidence is accumulating from a range of study methods that higher temperatures have severe effects on yields. That evidence comes from crop models, and statistical studies that evaluate how temperature fluctuations have altered crop yields.

One paper by researchers at Stanford University showed that a broad range of climate models indicate a 90 percent chance that *average* summer temperatures by the end of the century will exceed the highest record summer temperatures for the entire period 1900 to 2006.⁹³ The authors estimate on average a 10 percent decline in grain yields for each rise in temperature of 1 degree Celsius.⁹⁴ Another statistical analysis of past yield responses to temperature, predicted yield losses (absent adaptation) in the period 2046 to 2065 of 20-40 percent in many sub-Saharan African countries for maize, millet, groundnuts, and millet.⁹⁵ A 2009 paper using crop models by the International Food Policy Research Institute estimated that by 2050, average rice, wheat, and maize yields will decline in the region by up to 14 percent, 22 percent, and 5 percent, respectively.⁹⁶ An even more recent paper examined how temperature has affected maize yields in African field studies and estimates that a rise of even a single degree Celsius is likely to lead to maize yield losses of 20-30 percent in much of the region.⁹⁷ One paper has found that climate change has already had yield effects through these higher temperatures.⁹⁸

⁹³ D.S. Battisti, R.L.Naylor. (2009), "Historical warnings of future food insecurity with unprecedented seasonal heat," *Science* 323:240-244.

⁹⁴ D. Battisti, R.L. Naylor (2009), "Risks of extreme heat and unpredictability: Exchange," *Science* 324:177-178.

⁹⁵ W. Schlenker, D.G. Lobell (2010), "Robust negative impacts of climate change on African agriculture," *Environ. Res. Lett.* 5.

⁹⁶ G. Nelson et al. (2010), *Food Security, Farming and Climate Change to 2050: Scenarios, Results, Policy Options*, IFPRI, Washington, DC.

⁹⁷ D. Lobell et al. (2011), "Nonlinear heat effects on African maize as evidenced by historical yield trials," *Nature Climate Change* 1:42-45.

⁹⁸ D. Lobell, W. Schlenker, J. Costa-Roberts (May 5, 2011), "Climate trends and global crop production since 1980," *Science Express*, 10.1126/science.1204531.

Despite their modest contributions to the climate problem, Africans probably have more at stake in world solutions to climate change than the citizens of any other region.

These changes imply that in the absence of other compensating efforts, food will be less abundant and more expensive. Without major investments in agriculture, the IFPRI study predicted that the average sub-Saharan person would have access to 21 percent fewer calories and that climate change would increase the number of malnourished children by 10 million. The changes also imply that subsistence farmers will have a particularly difficult time because their limited access to capital and to markets provide them with less capacity to buffer bad years with good years.

Increased risks of crop failure due to weather make it harder to justify investments in inputs, such as fertilizer. Periods of difficulty also undermine the slow accumulation of machinery, livestock, and land improvements that is necessary for increasing productivity.

With the degree of climate change that is already unstoppable, large investments in adaptation are critical. Yet the scope of warming beyond 2050 threatens to overwhelm what adaptation can reasonably hope to accomplish. Despite their modest contributions to the climate problem, Africans probably have more at stake in world solutions to climate change than the citizens of any other region.

The Effects of African Agriculture on Climate Change

Although climate change will have serious effects on world agriculture, agriculture also has serious effects on climate change. Today, emissions that result from the production of agricultural crops probably account for roughly 14 percent of world greenhouse gas emissions.⁹⁹ Emissions from land use change contribute another 10-15 percent, and those changes are overwhelmingly associated with agricultural expansion.¹⁰⁰ The bulk of production emissions occur in the form of the potent greenhouse gases

⁹⁹ J. Bellarby et al. (2008), *Cool Farming: Climate Impacts of Agriculture and Mitigation Potential* (Greenpeace, Amsterdam).

¹⁰⁰ Y. Malhi (2010), "The carbon balance of tropical forest regions, 1990-2005," *Current Opinion in Environmental Sustainability* 2:237-244; G. R. Van der Werf et al. (2009), carbon dioxide emissions from forest loss. *Nat Geosci.* 2:737-738.

methane and nitrous oxide. Methane results primarily from the digestion of livestock, rice paddies, manure handling, and the burning of grasslands and savannas to stimulate better forage. The bulk of nitrous oxide results from urine and manure deposited on grasslands by livestock, and fertilizer use or the fixation of nitrogen by crops. Energy use in agriculture, to run machinery, and to make fertilizer and pesticides probably contributes only around 2 percent of world emissions. Land use change emissions result overwhelmingly from tropical deforestation and the associated drainage of peatlands in Southeast Asia.

As agriculture expands to meet the needs of more than 9 billion people, under business as usual emissions will probably grow by more than half. Estimates of future emissions from world land use change vary greatly, and could either fall or increase, but if they stay the same, the combination of land use and agricultural production emissions could generate 15 gigatons of greenhouse gas emissions per year by 2050.¹⁰¹ (All emissions in this paper are expressed in carbon dioxide equivalents regardless of the greenhouse gas.)

Many countries have endorsed a goal of halving 1990 world emissions by 2050, for a target of 20 gigatons per year from all sources. (By some estimates, that level of emissions would have a 50 percent chance of stabilizing the climate at “only” two degrees Celsius higher than pre-industrial temperatures.) If agriculture and land use change generate 15 gigatons in that year, all other sources of emissions could generate only 5 gigatons, including all world energy use, concrete production, landfills, and industrial sources of nitrous oxide and methane. With energy use potentially more than doubling by 2050 compared to 1990 levels, and emissions from energy, concrete, waste, and all other sources at roughly 30 gigatons in 1990, that is not a feasible task, implying the need for reductions in all other emissions worldwide compared to business as usual on the order of 90 percent. Put another way, agriculture and land use would generate three-quarters of these allowable emissions in

¹⁰¹ This figure uses 2050 figures of 8.7 gigatons for world emissions of nitrous oxide and methane from agriculture under baseline conditions in A. Popp, H. Lotze-Campen, B. Bodirsky (2010), Food consumption, diet shifts, and associated non-carbon dioxide greenhouse gases from agricultural production, *Global Environmental Change* 20:451-462. It also assumes that emissions from biomass burning remain at roughly 0.6 gigatons as set forth in Smith et al. 2007, that land use change remains at roughly 5 gigatons as elsewhere set forth in this paper, and that energy use in agriculture remains at roughly 1 gigaton as reported by the CDIAC, <http://cdiac.ornl.gov/trends/>.

The developing world generates roughly three-quarters of emissions from agricultural production.

2050 despite producing what will certainly be less than their contribution today of 6 percent of world GDP, a figure that also includes the economic output of forestry and fishing.¹⁰²

The developing world generates roughly three-quarters of emissions from agricultural production,¹⁰³ and — less surprisingly — nearly all emissions from land use change.¹⁰⁴

Sub-Saharan Africa's agricultural production emissions, not counting energy use in agriculture, are something on the order of 1 gigaton today and are likely to rise to roughly 1.85 gigatons per year by 2050.¹⁰⁵ Meanwhile emissions from African land use change today are estimated at levels ranging from 0.55 gigatons to 1.6 gigatons as discussed below. Together, agricultural emissions and land use constitute the substantial majority of the region's total greenhouse gas emissions. In 2050, even using these lower land use change estimates and assuming they remain unchanged, total land use and agricultural production emissions from sub-Saharan Africa would contribute roughly 2.4 gigatons. That would equal 12 percent of the 2050 goal, although agriculture would contribute less than the 0.2 percent of world GDP it contributes today.¹⁰⁶

Obviously, these greenhouse gas emissions cannot provide an excuse for failing to develop African agriculture. No realistic path out of hunger exists that does not involve large increases in food production in Africa. Africans can rightly claim that they contribute less to climate change than the people of any other

¹⁰² GDP data are published by the U.S. Central Intelligence Agency at <https://www.cia.gov/library/publications/the-world-factbook/fields/2012.html>.

¹⁰³ P. Smith, et al. (2007), Agriculture, in *Climate Change 2007: Mitigation*. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on climate Change [B. Metz et al. (eds)], Cambridge University Press, Cambridge.

¹⁰⁴ Malhi op. cit.

¹⁰⁵ The 2050 emissions in Popp, op cit., are estimated at roughly 1.55 gigatons, but neither include emissions from biomass burning nor emissions from energy use in agriculture. Biomass burning in Africa contributes roughly 0.3 gigatons of greenhouse gas emissions according to IPCC estimates through a combination of methane and nitrous according to IPCC estimates. P. Smith et al. (2007), op. cit. The figure of 1.85 assumes those biomass emissions will continue and leaves out energy emissions in African agriculture.

¹⁰⁶ According to the FAO, sub-Saharan Africa contributes 1 percent of world GDP, and on average 20 percent of its GDP comes from agriculture. FAO (2008), *Interventions for Improving Livelihoods in sub-Saharan Africa* (Rome) p. 18.

continent. From energy use, each African emits around 1 ton per person of carbon dioxide from energy use compared to 18 tons for each North American,¹⁰⁷ and Africa contributes less than 5 percent of world emissions overall.¹⁰⁸ Yet the whole world has a stake in helping African agriculture grow in ways that also limit the resulting greenhouse gas emissions.

The Potential for Agricultural Synergies on Climate and Food Security

Boosting food security while mitigating agricultural emissions presents a daunting challenge. To reach the goals completely will in all likelihood require major technological innovations. Thirty governments have recently agreed to work together to pursue this necessary research through the Global Research Alliance on Agricultural Greenhouse Gases. But in the interim, practical opportunities already exist to pursue both goals simultaneously because they generally involve increasing agricultural productivity. Africa produces today only 2.8 percent of world agricultural output,¹⁰⁹ but that same agriculture generates an estimated 14 percent of agricultural emissions.¹¹⁰ Increasing this production through the efficient use of inputs and land provides an opportunity to help address food security while holding down emissions.

Increasing production through the efficient use of inputs and land provides an opportunity to help address food security while holding down emissions.

The potential synergies on food security and climate fall into two categories. One involves ways of boosting productivity that reduce the emissions from the production process — particularly methane

¹⁰⁷ Carbon Dioxide Information Analysis Center, http://cdiac.ornl.gov/trends/emis/tre_afr.html (CDIAC). As discussed in one interesting article, the primary distinction among emissions is between affluent and poor people wherever they reside. Chakravarty, S. (2009), "Sharing global CO2 emission reductions among 1 billion high emitters," PNAS 106:11885-11888.

¹⁰⁸ Using 2005 figures, this assumes roughly agricultural emissions of 1 gigatons of emissions from the combination of sub-Saharan Africa and North Africa and the Middle East taken from Smith et al. (2007), p. 504, land use change emissions of 0.2 gigatons as discussed elsewhere in this paper, and emissions of roughly 1 gigatons from energy use and concrete manufacturer taken from CDIAC, op. cit., for a total of 2.2 gigatons out of 50 gigatons worldwide.

¹⁰⁹ Authors calculations from FAOSTAT.

¹¹⁰ Smith et al. (2007), op. cit.

and nitrous oxide — per kilogram of food. Of these, improved diets for livestock are by far the most important opportunity in Africa. The other category involves ways of boosting yields while preserving forests and savannas and therefore their carbon storage and ongoing sequestration.

Boosting Productivity While Mitigating Production Emissions

Livestock Improvements

Africa is home to roughly 250 million cows and 500 million sheep, as well as 1.5 billion poultry animals, and 25 million pigs.¹¹¹ Although estimates vary, livestock appear to generate 75 percent of sub-Saharan Africa's direct production emissions from agriculture (excluding biomass burning) through the methane emitted from the guts of cows, sheep, and goats and the nitrous oxide generated by their urine and manure.¹¹²

Fortunately, livestock probably provides the easiest and most economical opportunities for reducing emissions per kilogram of milk or meat. In the developed world, strategies for mitigating greenhouse gas emissions from livestock focus on a range of alternative feeding supplements, but in the developing world there is an easier option: become more productive and efficient. The relative benefits of such gains in poultry and swine production are more complicated and yet to be fully worked out, but the gains of productivity improvements in cows and sheep, which produce methane, are clear.

Relative to the quantity of meat and milk they generate, Africa's livestock generate far higher emissions than livestock elsewhere. For example, a study by the FAO published last year found that

¹¹¹ www.africalivestockdata.org/afrlivestock/sites/africalivestockdata.org/files/Livestock%20data%20in%20Africa_0.pdf.

¹¹² Different ways of categorizing emissions may explain why the dominant role of livestock in African emissions is not always completely clear. The 2007 IPCC reports identified all emissions of nitrous oxide from soils in one category, whether the nitrogen resulted from fertilizer application on cropland or the direct deposit of manure and urine from grazing animals. The role of the livestock particularly in generating these emissions is therefore not clear. The Popp article, *op cit.*, makes clear that the vast bulk of nitrous oxide emissions in Africa result from nitrogen generated by livestock. This article leaves out emissions from biomass burning, but estimates roughly 750 million tons of greenhouse gas emissions from livestock-related sources of methane and nitrous oxide.

dairy production on average in sub-Saharan Africa generated 7.5 kilograms of greenhouse gas emissions per kilogram of raw milk of a globally average quality (reflecting fat and protein content), while dairies in the United States generated only 1.3 kilograms, less than one-fifth.¹¹³

The emissions are high in part due to low yields of beef and milk. Africa has 14 percent of the world's dairy cows but only 2 percent of the world's dairy production.¹¹⁴ Africa's lactating dairy cows produce far less milk per cow than cows in other countries due to poor nutrition, poor health care, and lower yielding varieties. In addition, because of lower birth rates and higher death rates, more mother cows are needed to produce each new milk cow. As a result, more of the feed used to support dairy production is used to keep cows alive and less is directed into the milk output, which results in more emissions of methane and nitrous oxide per kilogram of milk.¹¹⁵ The poor quality of the feed and forage consumed by cows also results in more methane for each ton of feed. In general, the lower the energy value of feed, the more of the feed that is converted in guts into methane and the less that is absorbed for energy by the animals.

A variety of studies, using different methods, have found that improving the quality of feed has a large effect on greenhouse gas emissions per liter of milk or kilogram of meat. A study last year by the FAO found that a 10 percent increase in the digestibility of feed in an extensive system resulted in a 19 percent reduction in greenhouse gas emissions per liter of milk.¹¹⁶ A separate paper by Thornton and Herrero focused only on methane emissions but using more specific calculations and data for different parts of

In general, the lower the energy value of feed, the more of the feed that is converted in guts into methane and the less that is absorbed for energy by the animals.

¹¹³ P. Gerber et al. (2010), *Greenhouse Gas Emissions from the Dairy Sector: A Lifecycle Assessment*, FAO, Rome.

¹¹⁴ H. Menzi et al. (2010), "Impacts of intensive livestock production and manure management on the environment," in Steinfeld et al. (eds) *Livestock in a Changing Landscape: Drivers, Consequences and Responses*, Island Press, Washington p. 140.

¹¹⁵ Thornton, P., M. Herrero, Potential for reduced methane and carbon dioxide emissions from livestock and pasture management in the tropics, *PNAS* 107:19667-19672.

¹¹⁶ Gerber op. cit., p. 46.

Africa found reduction in methane emissions from feasible feeding improvements that ranged from 57-77 percent per liter of milk or per kilogram of meat for the actual producing animals.¹¹⁷

Substantially reducing these emissions does not require a wholesale transition to large-scale, grain-based livestock along the lines of the United States, nor even a move toward highly intensive, managed grazing systems as practiced in New Zealand. Most of the livestock in sub-Saharan Africa are in mixed grazing and cropping systems and along with native pastures rely heavily on crop residues and in some cases low protein forage grasses. The Thornton and Herrero paper identified several alternative options for improving this feed quality in animals actively producing milk or meat, all of which reduced methane emissions by more than half from the actively producing cows:

- Improving the digestibility of the residues from 40 percent to 50 percent, primarily by planting new varieties of sorghum, maize, and other grains that were bred to have more digestible residues.
- Feeding supplemental grain by 2 kilograms per day instead of half a kilogram.
- Planting a high protein forage shrub, whose leaves and branches are then cut and fed to livestock as a supplement. In that case, 1 kilogram of shrub replaces half a kilogram of residues and half a kilogram of grain.

In a separate, more recent analysis, Herrero has calculated comparable savings by replacing poor quality grasses with higher quality grasses, such as the brachiaria species.¹¹⁸ Interestingly, brachiaria is an African grass introduced and planted on improved pastures in Brazil but not much planted in Africa.

These improved feeding practices would also dramatically improve yields per animal, and in fact achieve their emissions reductions in part through those increased yields. Thornton and Herrero

¹¹⁷ Thornton P.K., M. Herrero op cit. Unlike the FAO study, this paper did not estimate overall life cycle emissions, but only the emissions from the animals actually producing milk or meat and only assumed that improved feed would be provided to these animals.

¹¹⁸ Herrero, M. (2011), Chart of methane emissions by livestock system for sub-Saharan Africa provided to the author.

calculate that the adoption of feed shrubs would produce even larger mitigation by freeing up land and sequestering carbon because of this higher efficiency.

These synergistic opportunities do not automatically follow from improved feed availability. For example, if farmers respond to improved pasture by increasing the number of animals, they would sacrifice much of the greenhouse gas improvements and probably much of the increased food production. Farmers in Africa may do so because of strong cultural traditions favoring cattle ownership or because they view a larger number of animals as a mechanism for surviving drought.

Actually achieving these gains will not be easy. Farm sizes are so small in many African countries that cooperative efforts would be necessary to support efficient livestock production. The costs of some of these measures would only be justified by the ability to market some of the resulting milk, which depends on better transportation and marketing infrastructure. Some practices require more labor, which can be in short supply in light of the high work demands of African agriculture. And planting brachiaria is typically done now in Latin America with mechanized equipment, which is limited in Africa.

Yet by international standards, these are all modest improvements. According to the FAO, African emissions per liter of milk exceed twice those of Latin America and South Asian emissions by 50 percent. Reaching the efficiencies of these other developing regions should be feasible.

Rice Management

Rice consumption is growing at 6 percent per year in sub-Saharan Africa; a Coalition for African Rice Development seeks to double Africa's rice production by 2020 alone. Japan's development agency spurs this effort, with the support of groups such as the Alliance for a Green Revolution in Africa (AGRA) and Oxfam, because rice is highly nutritious, loved by consumers, and can generate high yields. But rice on average generates roughly four times the

Rice on average generates roughly four times the emissions of wheat and maize.

emissions of wheat and maize.¹¹⁹ The flooding of fields for paddy rice creates the perfect conditions for bacteria to generate methane and, depending on how the water is managed, nitrous oxide as well. The Potsdam group estimates rice will generate roughly 200 million tons of greenhouse gases by 2050 in sub-Saharan Africa.

Fortunately, factors that influence emissions from rice fields have received a fair degree of study, and many help to boost yields.¹²⁰

- *Removal of rice straw:* In general, removing rice straw from rice paddies and keeping water levels dry before the growing season substantially reduces emissions. It does not necessarily reduce yields but could supply an alternative energy source.
- *Water level drawdowns:* In China, drawing down water levels during the middle of the growing season both increases yields and reduces overall emissions. Although this drawdown increases nitrous oxide emissions, the reduction in methane emissions makes this effort worth it. In other countries, however, farmers believe these drawdowns lead to yield losses, and emissions reductions may not be as great. That different experience may be due to the precise management of the drawdown, and synthesizing and analyzing the different experience has yet to occur fully.
- *Soil types:* The underlying soil types heavily influence the level of emissions, with sandier soils common in India generating much lower methane emissions than the heavier and more organic soils of China. In addition, the creation of new rice fields can cause large carbon losses from both soils and vegetation, with the drainage of organic soils likely to create the largest emissions. The lands into which Africans expand rice production can therefore heavily influence emissions. Africans can probably limit these emissions by focusing on existing fields where irrigation can be improved.

¹¹⁹ B. Linquist et al. (2011), An agronomic assessment of greenhouse gas emissions from major cereal crops (in press).

¹²⁰ Yan, X. et al. (2005), "Statistical analysis of the major variables controlling methane emission from rice fields," *Glob. Change Biology* 11:1131-1141; Yan, X. et al. (2009), Global estimations of the inventory and mitigation potential of methane emissions from rice cultivation conducted using the 2006 Intergovernmental Panel on Climate Change Guidelines, *Glob. Biogeochemical Cycles* 23, doi:10.1029/2008GB003299. Presentation of Tapan Adhya of the Central Rice Institute, Cuttack, India, provided to the author June, 2011.

- *Fertilizer type and quantity*: Fertilizer levels can have large impacts on nitrous oxide emissions, depending on how they are managed. In different fields, there may be threshold levels at which emissions rapidly escalate.
- *Rotations and out-of-season drainage*: Drying paddies out of season, and rotating rice with upland crops in various ways can reduce methane emissions substantially.
- *Yields*: If yields are high, the emissions per kilogram of rice tend to be lower, so general good farming practices have their own value. One way to achieve such yields is to select the best rice cultivar.

Some of these issues raise trade-offs. For example, some carbon-rich floodplain soils that should be avoided for greenhouse gas purposes may be highly productive for rice.

Fortunately, many of the ways of avoiding emissions can also boost productivity. Analyses of these various management options at the Central Rice Institute in Cuttack, India, have found in specific situations 40 percent increases in yields for the correct rice cultivar, 20 percent increases in grain yield for the application of potassium in some fields, and up to three-fold increases in net profit for certain rotations that also greatly reduced emissions.¹²¹

The System of Rice Intensification (SRI) provides a relatively innovative approach to rice production that may help both boost yields and reduce emissions. Madagascar has pioneered the growing of paddy rice with frequent drainage and modest flooding that has gained this generic title. Intended in part to conserve water, SRI generally focuses on keeping soils damp rather than flooded and adds water only as needed. Some techniques attempt to aerate the soil by disking. Planting patterns also differ. The original focus used organic material rather than synthetic fertilizer. In general, studies by supporters report large yield gains, sometimes by more than 50 percent, and similar-sized reductions in water use.¹²² One less-studied question is the potential impact on greenhouse gas

¹²¹ Adhya, op cit.

¹²² Africare, Oxfam, World Wildlife Fund (2010), *More Rice for the People, More Water for the Planet: System of Rice Intensification (SRI)*.

emissions although reductions have been reported.¹²³ Because of reduced water-logging, reductions in methane are to be expected and have been reported, but there can also be increases in nitrous oxide emissions, which may depend on the level of fertilizer applied. The emphasis on adding plant residues runs counter to other approaches to reduce methane.

Another promising technique involves the delivery of nitrogen fertilizer in the form of supergranules, which look like small golf balls, that farmers can make themselves from urea and then directly place in paddies next to the rice plant. The technique is spreading in Bangladesh, and has been estimated to increase yields 17-33 percent while decreasing nitrogen application by 33 percent.¹²⁴ Although not directly studied yet, that reduced nitrogen application should translate into fewer greenhouse gas emissions. Although highly successful in Bangladesh, at least one major research group in China has not found comparable yield benefits there, perhaps because Chinese farmers apply extraordinary levels of nitrogen fertilizer.¹²⁵

Both SRI and supergranules would appear to hold great promise in Africa. Finding alternative uses for rice straw would also be promising, and developing rice on soils less likely to lead to carbon losses and methane emissions should also be technically achievable. What is needed is rapid study to analyze the variables and establish recommendations for a range of conditions and testing rice growing techniques in different ways and in different combinations. The responses both in yields and greenhouse gas emissions then need to be monitored and the knowledge incorporated into rice promotion strategies.

¹²³ S. Hidayah et al. (undated), Intermittent Irrigation in System of Rice Intensification, Potential as an Adaptation and Mitigation Option of Negative Impacts of Rice Cultivation in Irrigated Paddy Field, Experimental Station for Irrigation, Indonesia; Tapan Adhya, Central Rice Research Institute, Cuttack, India, personal communication May, 2011.

¹²⁴ Data provided by International Fertilizer Development Corporation (IFDC). The opportunities and challenges for using supergranules vary according to a variety of conditions. S.K. Mohanta et al. (1999), Nitrogen deep-placement technologies for productivity, profitability, and environmental quality of rainfed lowland rice systems, *Nutrient Cycling in Agroecosystems* 53: 43-57. According to the IFDC, which invented and has promoted this technique, impediments from high labor requirements discussed in that article have been reduced by improved planting techniques.

¹²⁵ Xiaoyuan Yan, Institute of Soil Science, Chinese Academy of Sciences, Nanjing, personal communication October, 2010.

Balanced Fertilization

Outside of Africa, nitrogen fertilization probably contributes on the order of 3 percent of all human greenhouse gas emissions through emissions of nitrous oxide from fertilized soils, and through the energy use to make the fertilizer. Soil emissions occur even when the nitrogen results from the fixation of nitrogen by plants. In Africa, however, nitrogen fertilizer use is modest with total fertilizer use of all kinds less than 10 kilograms per hectare.¹²⁶ Nitrous oxide also depends on the availability of carbon for microorganisms to eat along with nitrogen, and Africa's greatly depleted soil carbon probably also contributes to low emissions. Fertilization therefore contributes little to Africa's greenhouse gas emissions, according to present estimates although these emissions will grow as African agriculture improves.

Improving fertilization through both synthetic fertilizer and plant fixation is critical to boosting African yields. According to some studies elsewhere of under-fertilized soils, increased yields could in the right circumstances also boost soil carbon. In the short run, the best approach to fertilization is to encourage balanced fertilization that includes nitrogen fixing plants, nitrogen fertilizer and the additional of phosphorus and other appropriate fertilizers as well. In Africa, the cheapest way to limit emissions of nitrous oxide per unit of crops is to make sure fertilizer is used efficiently to generate more food.

In Africa, the cheapest way to limit emissions of nitrous oxide per unit of crops is to make sure fertilizer is used efficiently to generate more food.

Producing More Food While Protecting Forests and Savannas

Preserving Africa's Forests: The Stakes

The most prevalent greenhouse gas is, of course, carbon dioxide. The atmospheric concentration of carbon dioxide increases whether the carbon derives from burning fossil fuels underground, or burning and plowing up plants and soils. Overall, the world's plants and soils contain roughly four tons of carbon for each ton

¹²⁶ J. Pretty et al., op. cit. "Sustainable intensification in African agriculture," *Int. J. Sust. Ag.* 9:5-24.

of carbon in the atmosphere. The conversion of forests causes the immediate release of nearly all the carbon in the trees and the probable loss over a few years of a quarter of the carbon in soils. The 2007 report of the IPCC found emissions from land use change uncertain, but placed the estimate at 17 percent of 2004 world greenhouse gas emissions.¹²⁷ A subsequent paper revised estimates for land use change from 2000-2005 to around 12-15 percent in part because FAO revised the underlying data on deforestation and in part because greenhouse gas emissions from energy use have continued to grow, reducing the percentage but not the absolute quantity of emissions from land use change.¹²⁸ (The FAO has actually re-revised these figures upward in its most recently world forest assessment.¹²⁹)

The tropics generate virtually all of these emissions because that is where the net forest clearing for other land uses is happening.¹³⁰ Large harvests of forests occur in temperate areas as well, but under the accounting rules used internationally, the regrowth of other forests harvested decades ago cancels out these ongoing harvests. There are also very large-scale losses of forest cover due to fires and insect invasions, particularly in the cold “boreal forests” of Russia and Canada. Global accounting rules typically leave out these losses because they are not attributed to human behavior. The IPCC based its estimate on data of forest changes compiled by the FAO from the 1990s, but there are long and well appreciated limitations with FAO data. Scientists now generate alternative estimates using databases of two different collections of satellite photographs, but the global versions of these analyses focus only on wetter tropical forests and suffer some of their own limitations. One recent paper, which averaged these estimates from satellite photographs and then extrapolated to dry forests, came up with a best estimate that land use change contributes roughly 5 gigatons of carbon dioxide per

¹²⁷ T. Barker et al., Technical summary. in B. Metz et al. (eds), *Climate Change 2007: Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change* Cambridge University Press, Cambridge, United Kingdom p. 28.

¹²⁸ Van der Werf et al. *op. cit.*

¹²⁹ FAO (2010), *Key Findings Global Forest Resources Assessment 2010*, Rome.

¹³⁰ R.A. Houghton (2008), in *Trends: A Compendium of Data on Global Change* (Oak Ridge National Laboratory, US Department of Energy) 2008, available at: <http://cdiac.ornl.gov/trends/landuse/houghton/houghton.html>.

year that was ultimately similar to the IPCC estimates from FAO data.¹³¹

Viewed on a percentage basis, the increase in agricultural area has been small according to FAO statistics, increasing from 4.5 billion hectares in 1960 to 4.9 billion hectares in 2007.¹³² But this increase of a mere 9 percent amounts to a total of 400 million hectares, an increase of 8.5 million hectares per year. These net global figures also underestimate the carbon challenge because they camouflage a large regional swing. Between 1990 and 2007, roughly 35 million hectares of forest gains in Europe and the United States and nearly 50 million hectares claimed in China partially offset 230 million hectares of forest loss elsewhere. While the net forest loss was still 8.5 million hectares per year, the gross forest loss in the tropics, according to the latest FAO figures, was 16 million hectares per year in the 1990s, and 13 million hectares in the last decade.¹³³ Every hectare of agricultural land conversion in the tropics causes on average the release of three times as much carbon per ton of crop yield as the conversion of a temperate hectare.¹³⁴

Estimates of African emissions vary significantly. R.K. Houghton estimated African emissions from 2000 to 2005 at an average of 0.89 gigatons of carbon dioxide,¹³⁵ while the most recent Forest Resources Assessment by FAO lists the losses for all of Africa at 1.66 gigatons of carbon dioxide in the last five years, nearly all in the sub-Saharan region.¹³⁶ Although Houghton reports comparable land area cleared in Africa as in Latin America, emissions are only 10 to 15 percent of world land use change emissions, far smaller than

Every hectare of agricultural land conversion in the tropics causes on average the release of three times as much carbon per ton of crop yield as the conversion of a temperate hectare.

¹³¹ Malhi, op. cit. The FAO data method is reflected in the figures provided for Houghton in Table 1 of this paper.

¹³² P. Smith (2010), Competition for Land, *Phil. Trans. Royal Society* 365:2941-2957.

¹³³ FAO (2010) op cit.

¹³⁴ P. West et al.

¹³⁵ Houghton, op cit., averaging figures for 2000 through 2005.

¹³⁶ FAO (2010, op cit.). Tables 2.22 through 2.24 express changes in forest carbon stocks for living biomass (1224 tons), dead biomass (223 tons) and soils (814 tons) from 2005 to 2010, and when converted to annual losses of carbon dioxide becomes 1.66 tons per year.

share of Latin America and Asia, because the forests cleared are drier and less carbon-rich.¹³⁷ However, because of concerns with FAO data, Yavinder Malhi estimated annual emissions from 2000 to 2005 at only 0.55 gigatons, based on interpretations of satellite photographs, which estimate less deforestation. Even these low estimates of emissions equal half of the region's production emissions from agriculture.

Converting intact forests not only releases carbon immediately but also reduces the amount of carbon forests would otherwise absorb from the atmosphere.

Converting intact forests not only releases carbon immediately but also reduces the amount of carbon forests would otherwise absorb from the atmosphere. The best science now indicates that intact tropical forests are on balance growing, absorbing carbon dioxide and therefore serving as a large net sink. The evidence has accumulated from a wide range of sample sites of undisturbed forests and corrects what had been a longstanding consensus that mature forests had reached a state of equilibrium and no longer gained

carbon. No one is quite confident of the cause but explanations focus on the stimulating effect on plant growth of higher carbon dioxide concentrations, a beneficial feedback from climate change. According to one recent estimate, wetter intact tropical forests in Africa on average are building carbon at a rate equivalent to 2.3 tons of carbon dioxide per hectare per year.¹³⁸ To put that figure in perspective, forest plantings in Europe and the United States are often offered as greenhouse gas mitigation strategies, and they might build carbon at average rates of roughly 11 metric tons of carbon dioxide per hectare per year. Preserving humid African forests therefore not only saves as much as 200 tons of carbon already stored in trees and soils,¹³⁹ but generates future gains at a nontrivial rate as well.

¹³⁷ Houghton, op. cit.; Malhi op. cit.

¹³⁸ Malhi, op. cit.

¹³⁹ H. Gibbs et al. (2008), Carbon payback times for crop-based biofuel expansion in the tropics: the effects of changing yield and technology, *Environ. Res. Lett* 3, 034001, Supporting Information Table S1.

In 2006, the FAO projected that Africa would lose 30 percent of its forests by 2050,¹⁴⁰ and Africans have more than a shared global interest in preventing that from happening because forest clearing in Africa could also have harsh regional effects. Forests generate higher levels of water vapor in the atmosphere than other land uses, and this vapor has a regional cooling effect and tends to create greater local rainfall. A group of modelers at the University of Bonn analyzed what the 30 percent loss of forest in Africa would do to Africa's own regional climate when combined with different levels of global warming. According to their model, the effect is to increase temperatures enough that the best climate scenario analyzed by the IPCC (with the world's lowest projected greenhouse gas emissions) has the same warming effects in central and northern sub-Saharan Africa as the worst climate scenario. The precipitation effects would be worse, according to this model, with a general decline in rainfall of 300 millimeters per year. Such changes would have harsh effects on the region's most productive farmland belt stretching from West to Central Africa, which feeds the region's largest populations.¹⁴¹

In short, while Africans have an overriding interest in increasing their agricultural production, both Africans and the rest of the world share an interest in preserving Africa's forests.

The Importance of Yield Gains to Forest Protection

The global public benefit of preserving Africa's forests translates into a potential global public benefit from increasing Africa's agricultural productivity. Because of stagnant yields, two-thirds of the increases in African food production between 1961 and 1999 resulted from expansion of the area harvested and only one-third from yield gains.¹⁴² By contrast, yield gains in Asia accounted for 80 percent of the increased production, with much of the remainder resulting from an increase in double and triple cropping.¹⁴³

¹⁴⁰ FAO (2006) Global forest resources assessment 2005: Progress towards sustainable forest management. FAO Forestry Paper, Rome p. 147.

¹⁴¹ H. Paeth, et al., Regional climate change in tropical and northern Africa due to greenhouse forcing and land use change, *J. Climate* 22:114-132 (2008).

¹⁴² P. Smith et al. (2010), op. cit.

¹⁴³ P. Smith et al. (2010), op. cit.

For reasons of basic arithmetic, increases in crop yields and other gains in agricultural efficiency — such as more efficient feeding of livestock — translate into more food per hectare and therefore less land in agricultural use worldwide to produce the same amount of food. These gains are critical to meeting world food needs while preserving the carbon stores in forests. Various estimates by UN organizations point to a need for increases in food production by 2050 of 70-80 percent. By definition, unless that can be achieved through a combination of higher yields and livestock production efficiencies on existing land, new land will be needed. Using similar math, without the yield gains achieved from 1961 to 2007, one paper calculated that more than twice as much cropland would be needed today to sustain the same population.¹⁴⁴

A few calculations estimating how much food sub-Saharan Africans will need by 2050 highlights the importance of yield gains. The region today imports 25 percent of the grain it consumes, and even with these imports, according to the FAO, its people have available to them for consumption only 2,455 calories per person per day.¹⁴⁵ Because of losses during the distribution process, actual human consumption is lower. By contrast, people in transitional economies have roughly 3,100 calories available to them, and those in developed economies have more than 3,500. The United Nations has recently projected that Africa's population will grow from 856 million to 1,960 million by mid-century (using the medium level estimate).¹⁴⁶ Without yield gains, simply supplying the region's people the same inadequate level of food, while continuing to import a quarter of all consumed grain, cropland devoted to the region's own food production would have to increase 123 percent

¹⁴⁴ J.A. Burney JA, S.J. Davis, D.B.Lobell (2010), Greenhouse gas mitigation by agricultural intensification, *PNAS* 107:12052-12057; P. Smith (2010), Competition for land, *Phil. Trans. Royal Soc.* 365:2941-2957.

¹⁴⁵ Data in this paragraph are from FAOSTAT.

¹⁴⁶ United Nations Department of Economic and Social Affairs Population Division (2011), 2010 Revision of World Population Prospects, http://esa.un.org/unpd/wpp/unpp/panel_population.htm.

from 154 million hectares to 357 million hectares.¹⁴⁷ To put that figure into perspective, the increase equals roughly 150 percent of the entire cropland planted in the United States each year.

The figure is even larger if Africans are to produce all their own food to meet the FAO's optimistic consumption estimates for them in 2050 of 2,830 calories per person, including a modest increase in meat consumption. In that case, at present yields, they would need 488 million hectares (an increase of 334 million, or 317 percent). Using these figures as a total estimate of new agricultural land is actually conservative. Among other reasons, these figures assume no growth in the use of land for exports of Africa's high value agricultural products such as coffee, rubber, and vegetables, and also assume that the milk and meat now generated from grazing lands would rise proportionately with the rise in population without any expansion of grazing land. They also assume no land for biofuels.

Flipping the numbers, one can ask how much yields would have to grow in the region to produce these levels of food without expanding cropland. Merely to maintain today's insufficient food production, yields for all food crops would have to grow 230 percent, with cereals rising from 1.23 to 2.81 metric tons per hectare. To meet FAO's projected level of food consumption without relying on imports — still well below the food level for

¹⁴⁷ These calculations use food consumption balance sheets generated for Africa by FAO for 2007, and subtract North African data, <http://faostat.fao.org/site/368/default.aspx#ancor>. That results in a total of 2,306 Kcal/capita/day, including 2,159 Kcal from a vegetal products (including processed oils), and 146 Kcal from animal products, all broken down into a classification of commodities and products. The food supply, divided by the population gives the amount of food available in kg/capita/year, which is converted to nutritional components including energy (Kcal/capita/day), protein supply (g/capita/day), and fat supply (g/capita/day). To determine local crop production used for food, the calculations include food, feed, and crops used for processing and "other utilization" but subtract imports. These calculations result in the level of crop production within the region that could be turned toward feeding Africans from Africa. The production level for 2050 was calculated by multiplying the crop production per capita by the ratio of the population gain, which results in the level of production needed to provide the same quantity of food to Africans in 2050 as they presently receive. Matching FAO production statistics for major crop groups to the crop consumption categories generates the current area harvested, the production, and yield for domestic consumption. These figures were then be adjusted to reflect the different ways of meeting the higher level of food demand through yield or area gains. Roughly the same procedures were followed for the FAO scenario using the FAO's projection of food consumption in sub-Saharan Africa for 2050 as set forth at p. 26, Table 2.8 of FAO (2006), *Prospects for Food, Nutrition, Agriculture and Major Commodity Groups, World Agriculture Towards 2030/2050: Interim Report*, Global Perspective Studies, Rome.

transitional countries — cereal yields would have to grow 350 percent to 4.33 tons per hectare.¹⁴⁸

According to analyses at FAO, an increase of 334 million hectares of cropland would be within the range of the roughly 550 million hectares of additional potential cropland, but that includes extensive forests, wetlands, and many pasture lands that are already producing food. The carbon released would depend on the types of areas converted but could plausibly amount to 3 gigatons per year.¹⁴⁹ If yield and area growth each contributed half of the needed new food production, land use change emissions would still by this count equal 1.5 gigatons per year. Using the estimates of agricultural production emissions in 2050 discussed above, that would raise sub-Saharan Africa’s total emissions from agriculture and land use change to 17 percent of world target levels for all emissions.

Table 1 Cropland or Yield Gains Necessary to Feed Sub-Saharan Africa in 2050

	Current	2050-Current consumption Imports (2,306 kcal/person/day) & current reliance on imports	2050-FAO projection of food consumption (2,830 kcal/person/day) & self-sufficient regional production
Cropland needed at current yields for domestic food consumption (hectares)	154 million	357 million	488 million
Cereal yield needed to avoid new land clearing	1.23 t/ha	2.81 t/ha	4.33 t/ha

These figures place a high premium on yield gains, and economic reality presents an additional reason. Experience has shown that at current yields and overall productivity, agricultural expansion does

¹⁴⁸ The percentage increases of total cropland area versus cereal yield growth differ because total cropland increased reported refer to cropland for all crops, while yield gains (and land gains) needed for cereals alone are greater because of an increased proportion of cereals in the diet projected by FAO.

¹⁴⁹ Gibbs (2008) op cit. estimates above ground carbon for season and humid forests and savannas in Africa at 51 to 204 tons per hectare depending on whether the lands are shrub forest, disturbed or undisturbed, with potential soil conversion losses of 10 to 19 assuming that conversion loses 25 percent of soil carbon. At an average carbon loss rate of 100 tons/hectare, the conversion of 334 million hectares over 40 years would generate 835 million tons of carbon losses per year, or 3,062 million tons of carbon dioxide, i.e., 3.06 gigatons.

not pay greatly in Africa (except perhaps for the recent expansion of commercial farming for export due to large land concessions responding to the extremely high recent crop prices). Without yield gains, Africans would probably not plow up the full additional 334 million hectares of cropland they need to eat well. That would save some forests, but hunger would grow.

Achieving the yield gains necessary to achieve the FAO projections without adding cropland is a daunting task. For example, cereal yields on average would have to rise by an additional 72 kilograms per hectare each year. These growth rates are far higher than the world average but less than those in China from 1961 to 2006, which were roughly 90 additional kilograms per hectare per year starting from similar yields to those in Africa today. Yet most of China's cropland receives far more rainfall, and China has boosted yields through enormous improvements in irrigation and staggering levels of nitrogen fertilizer. The needed 2050 yields are also within those deemed attainable under rain-fed conditions using some crop models for fully intensive management.¹⁵⁰ Modeling undertaken by Dr. Phil Thornton of still ambitious but less intensive agriculture suggests more caution. His modeling estimates at most a doubling of maize yields in much of the wetter portions of sub-Saharan Africa if farmers in the region can use improved varieties and 50 kilograms of nitrogen per hectare on average. That level of nitrogen use is ambitious considering that farmers today on average use 6-7 kilograms per hectare of all kinds of fertilizer combined.¹⁵¹ Suggesting further caution, none of these results take account of the effects of climate change.

These challenges highlight the value of yield gains if the goals include both improved nutrition in Africa and protection of forests, savannas, and their carbon and biodiversity. These joint needs also indicate that common references to Africa's abundant supply of potential cropland are both wrong and dangerous. Land in Africa is as precious as it is everywhere else. It seems unlikely that Africans will be able to produce the food they need by 2050 without clearing some new land, but the goals should be to limit that land clearing

¹⁵⁰ Modeling by scientists at IIASA at <http://www.iiasa.ac.at/Research/LUC/GAEZ/index.htm>.

¹⁵¹ This modeling is for an upcoming paper submitted for a special issue of PNAS. Regional fertilizer use information can be found in J. Pretty et al., op. cit. "Sustainable intensification in African agriculture," *Int. J. Sust. Ag.* 9:5-24.

It seems unlikely that Africans will be able to produce the food they need by 2050 without clearing some new land.

as much as possible, boost yields, and focus land clearing on the production of food for Africans.

The Challenge of Productivity Gains to Forests

Unfortunately, merely boosting yields does not necessarily protect regional forests. The argument that yield gains spare land for nature is sometimes called the “Borlaug” hypothesis because the great plant breeder, Norman Borlaug, articulated it strongly. A 2001 book edited by two economists at the Center for International Forestry, Arid Angelsen and David Kaimowitz, set forth the wide range of different effects of intensification on tropical forests.¹⁵² In the last few years, economists and ecologists have continued to publish papers on the topic. Two papers published in 2009 found that there was no clear relationship between increases in yields for staple crops and reductions in the amount of cropland in total or per person in the countries or regions where the yield gains occurred.¹⁵³

The authors of these papers have offered several explanations of this apparent paradox.¹⁵⁴ Higher yields can lead to lower prices, which stimulate more demand so that total cropland does not decline. When cropland needs decline for basic staples, farmers may use cropland for other crops, such as fruits and vegetables, which is really another form of meeting increased food demand. The studies that focus on whether yield gains translate specifically into forest protection — as opposed to reduced conversion of any land use type — additionally emphasize that farmers can expand into a variety of areas, so even if land is spared, forests may still be used. Some studies point out that when productivity increases,

¹⁵² A. Angelsen, D. Kaimowitz (eds) (2001), *Agricultural Technologies and Tropical Deforestation*, CABI International, Wallingford, U.K.

¹⁵³ R. M. Ewer et al. (2009), “Do increases in agricultural yield spare land for nature?” *Glob Change Biol.* 15:1716–1726; T. Rudel et al., Agricultural intensification and changes in cultivated areas, 1970–2005, *PNAS* 106:20675–20680. One criticism of several of the statistical studies is that they do little to estimate how much land would be converted in the absence of yield increases. For example, the studies do not estimate how much food and therefore cropland would be needed because of rising incomes in a country in the absence of yield gains. If yields increase in countries that are growing economically in general, yield increases could still help save land but not reduce conversion altogether even in that country.

¹⁵⁴ A good summary is provided by A. Angelsen (2010), “Policies for reduced deforestation and their impact on agricultural production,” *PNAS* 107:19639–19644

those who own farmland have more money and may be better able to invest in clearing more land.

How do we resolve the apparent paradox? One feature of these papers is that they implicitly focus on a single goal: protecting forests. In fact, compared to other continents, Africa has done a fairly good job of protecting forests. But it has done so by feeding its people poorly. World policymakers have generally, and appropriately, identified two goals: protecting forests and producing more food to eliminate hunger. To the extent increased productivity reduces the costs of food and leads to increased consumption, that is a good thing overall, even if not good for forests. If the goal is to limit land use change while producing more food, then higher yields are essential and on a global basis translate mathematically into less overall cropland for the same quantity of food. For this reason, policy should support the pursuit of higher yields and productivity overall even if the increase in food consumption results in less forest protection than would be achieved by yield gains without more consumption. That approach should apply particularly to the production of staples needed by Africans themselves.

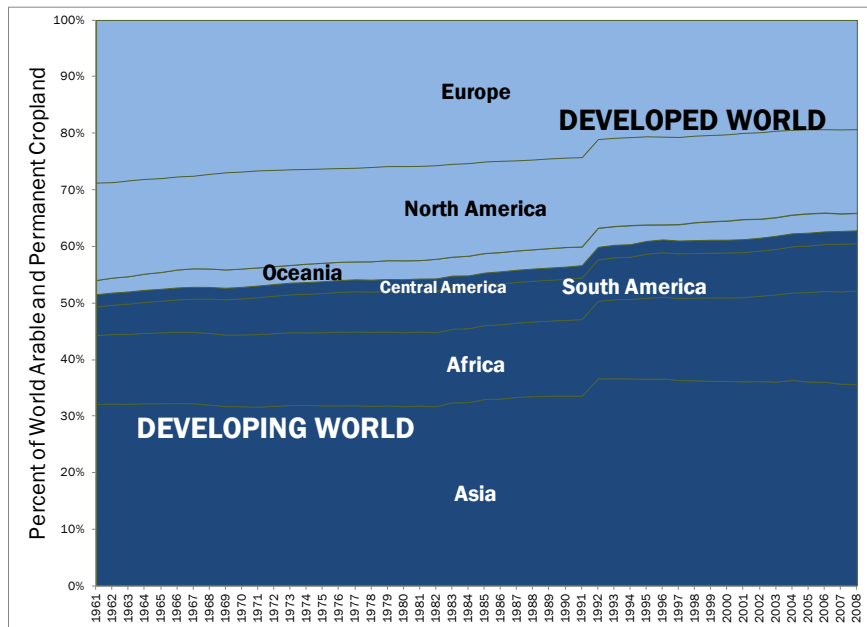
Compared to other continents, Africa has done a fairly good job of protecting forests. But it has done so by feeding its people poorly.

Expansion of rangeland provides another obvious reason crop yield gains may not closely correlate with rates of deforestation. Although the data are hard to interpret, the FAO could reasonably say the data indicates that expansion of rangeland has been responsible for two-thirds of agricultural land expansion over many decades.¹⁵⁵ Controlling or stopping this expansion, and generating the livestock and dairy products in different ways, provides another agricultural challenge for forest protection.

Yet the real public policy challenge raised by the studies casting doubt on the land-sparing theory — although often not discussed — is the difference between global land sparing and local or regional land use demand. That difference explains many of the studies that find no correlation between a country's yield growth and its demand for cropland. In an integrated world agricultural

¹⁵⁵ H. Steinfeld et al. (2006), *Livestock's Long Shadow*, FAO, Rome.

Figure 1 The Growing Percentage of Cropland from the Developing World



Source: FAOSTAT

market, there is no reason such a correlation should exist. Yield gains in a country will make its agricultural production more competitive and therefore more able to generate exports or more able to replace imports. As a result, agriculture in that country will increase relative to others given the same level of worldwide demand.

The regions today associated with the greatest emissions from deforestation — Southeast Asia and Latin America — are precisely the regions where dramatic yield gains have led to growing export agriculture for soybeans, livestock products and palm oil, among other agricultural products. Increases in agricultural productivity in tropical countries have contributed to a shift in agricultural land. Continuing a trend from 1990 to 2007, for example, agricultural land increased in Africa, Asia, and Latin America by around 120 million hectares, but declined by roughly 50 million hectares in

Europe and North America.¹⁵⁶ Studies project these trends to continue.¹⁵⁷

From an environmental standpoint, the problem is that these trade-offs are a bad deal. Losing a hectare of mature forest in the tropics today sacrifices more biodiversity and more carbon than is gained by allowing a hectare of temperate land to reforest. When measured as tons of carbon per ton of food, the deal becomes even worse because yields in temperate zones are higher, and each hectare cleared and devoted to crops in the tropics have on average released roughly three times the carbon per ton of crops as each hectare in the temperate world.¹⁵⁸ That reformulates the challenge: how does the world encourage higher productivity and more agricultural production both in Africa and other developing regions to enable people there them to feed themselves? How does it also afford them export opportunities to benefit their overall economy? And how does it simultaneously avoid regional shifts in cropland that lead to additional conversion of natural carbon-rich habitats?

How does the world encourage higher productivity and more agricultural production both in Africa and other developing regions to enable people there them to feed themselves?

A Balanced Vision for African Agricultural Growth

A reasonable, balanced approach to meeting these competing needs would seem possible. Instead of offering Africa as a potential breadbasket for the world, production of cereals and other staples should be geared toward meeting the needs of Africans, with a strong push to increase yields particularly among smaller farmers. Avoiding deforestation to expand pasture for beef production is particularly critical, as it is the largest source of agricultural deforestation in Latin America. But that does not mean neglecting agriculture as a source of exports and overall economic growth.

¹⁵⁶ U.K. Government Office for Science (2011), *The Future of Food and Farming: Challenges and Choices for Global Sustainability Final Project Report*, London, p. 56.

¹⁵⁷ J. Bruinsma (2003), *World Agriculture: Towards 2015/2030. Summary Report*, FAO, Rome; J. Bruinsma (2009), *The Resource Outlook to 2050: By How Much do Land, Water and Crop Yields Need to Increase by 2050?* Paper prepared for expert meeting on how to feed the world in 2050, Rome, FAO.

¹⁵⁸ P. West et al. (2010), Trading carbon for food: Global comparison of carbon stocks vs. crop yields on agricultural land, *PNAS* 107:19645-19648.

Export agriculture should focus on high value, labor-intensive crops, such as fruits and vegetables, coffee and cocoa, spices, and flowers.

Expansion of any export agriculture, on top of Africa's own food needs, implies more farmland and less forest, but high value agriculture generates more output, wealth, and jobs for each hectare of land. And this approach also plays to Africa's existing strengths. Agricultural production of nonstaples, including fruits, vegetables and plantation crops, such as coffee, cocoa, and rubber, use only 12 percent of the present cropland in the region.¹⁵⁹ Yet they generated net trade surpluses of \$15.6 billion for the region in 2004-5.¹⁶⁰ By contrast, sub-Saharan Africa had net imports worth \$5.5 billion of grains, livestock products, and other raw foods. Under this approach, staple crop production should focus on meeting African needs.

To a large extent, this approach follows the approach that Africa is already taking in export markets while focusing more efforts on producing its own food. It also means avoiding what appears to be the present wave of providing large concessions for African land to produce staples that will likely be destined for export. This approach leaves the bulk of African land for producing food for Africans.

Pursuing this vision has many concrete implications for agricultural development efforts:

- Road networks should try to avoid forests, and where they must go through forests, adjoining corridors should be protected.
- Research and extension efforts should follow the strategy of promoting only high value export agriculture while promoting staple development for domestic markets. Locally consumed crops, such as potatoes and sorghum, should receive their proper attention.

¹⁵⁹ Authors calculations based on data from FAOSTAT.

¹⁶⁰ M.A. Aksoy, F. Ng (2008), *Who are the Net Food Importing Countries?* Policy Research Working Paper 4457. Washington, D.C.: World Bank, Annex Table 6. In particular, fruits and vegetables generated net exports of \$2.944 billion, cash crops \$7.129 billion, and agricultural raw materials \$5.514.

- Fertilizer efforts should focus on helping farmers to apply or fix the first 50 kilograms of nitrogen per hectare, not increases from 150 to 200, in generating staple crops.
- Land expansion should ideally go where the yield per carbon loss ratio is low.

International cooperation can help Africa achieve these goals.

Following the Science on Carbon Sequestration

Ironically, one of the obstacles to focusing on these true opportunities for synergy may be an excessive focus on trying to mitigate emissions by sequestering carbon on agricultural lands, particularly in soils. Carbon sequestration strategies of various kinds represented 90 percent of the technical potential greenhouse gas mitigation identified in the last major mitigation report by the Intergovernmental Panel on Climate Change in 2007.¹⁶¹ A World Bank website states: “In agriculture, the main mitigation potential is based on the amount of soil carbon that is sequestered.”¹⁶²

Expansive views of soil sequestration potential are based largely on an equation that evaluates how much carbon agricultural soils have lost, details reasons that a variety of practices in general increase carbon in soils, and then estimates the percentage of this soil carbon that can be regained. The global potential for carbon storage in soils is accordingly large because the world has vast agricultural lands, which have lost a great deal of carbon.

In the last couple of years, many scientists have come to doubt this strong focus on soil carbon, and a recent review provides an excellent summary of this thinking.¹⁶³ The large estimates of carbon sequestration potential in soils are based in part on a reasonable estimate of the amount of carbon lost in agricultural soils, but a less solidly grounded estimate of what it takes to get some of that carbon back, and no analysis of the specific practices

¹⁶¹ Smith et al. (2007).

¹⁶² World Bank, Triple Win of Climate Smart Agriculture Put into Practice <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTSDNET/0,,contentMDK:22842518~menuPK:64885113~pagePK:7278667~piPK:64911824~theSitePK:5929282,00.html>.

¹⁶³ Powlson, D.S., A.P. Whitmore, K.W.T. Goulding (2011), “Soil carbon sequestration to mitigate climate change: a critical re-examination to identify the true and the false,” *European Journal of Soil Science* 62:42-55.

in specific locations needed to restore this carbon. Some new scientific papers have sown doubts. For example, many estimates of soil sequestration potential assume that restricted plowing or “no-till agriculture” increases soil carbon. But recent studies have questioned the data underlying that assumption because they mostly focused on soil carbon gains in the top few centimeters of soil, where carbon-rich residues concentrate in the absence of deep tillage. These new papers have found no consistent trend when examining the soil down as far as a meter. Other analyses have found that no-till often increases emissions of nitrous oxide enough to cancel out even significant increases in carbon gains from agriculture, at least over several initial years, which may be all that matters. The experience in the United States at least is that most no-till farmers tend to till up soils at least occasionally. Both subjects are under intense debate, and the results probably varies by soil type, but it will take several years at least before a new consensus emerges.

Many of the techniques promoted for increasing soil carbon require additions of carbon to the soil to achieve them.

Another major question is where the additional carbon for soils is to come from, and at what economic and carbon costs. Many of the techniques promoted for increasing soil carbon require additions of carbon to the soil to achieve them. If that carbon is added by cutting down other vegetation and using it as mulch, the activity may increase soil carbon at the expense of carbon in vegetation.

If manure is the source of the carbon, but that manure would otherwise be deposited on soil elsewhere, there may also be no net carbon gain. Crop residues are generally returned to the soil in developed countries, but in much of Africa they are used as an animal feed. Some crop residues are burned for fuel, so if they are instead returned to the soil, the carbon gained from this may not match the carbon released by replacing them with fossil fuels. A similar concern applies to carbon sequestration strategies that focus on taking agricultural land out of production to plant trees because that begs the question of what carbon might be lost in replacing the food elsewhere.

Although it seems harder to put carbon back into soils in conventional crop farming, there are alternative carbon

sequestration strategies. The most promising of these for Africa is probably agroforestry, for which there have been substantial numbers of pilot projects of modern techniques over recent decades to go along with more traditional systems.¹⁶⁴ Many systems focus on using nitrogen-fixing trees and shrubs as an organic fertilizer source. In some systems, farmers plant trees along with maize and then allow the trees to grow during traditional fallow periods, plowing them in for nitrogen gains. In other systems, these kinds of trees are inter-planted in rows with maize and other main crops. Studies of both systems in experiment stations and in practice have shown that they will often double or triple maize yields. Other agroforestry techniques plant high shrubs to generate high protein forages for dairy cows. In cocoa and coffee plantations, trees can provide valuable shade, which increases growth rates of young cocoa trees. And some agroforestry practices plant fruit and nut trees specifically for their fuel value.

Although there have long been forms of agroforestry, many of these techniques are new. Even so, because of their success, many such techniques are spreading in parts of southern, East and West Africa even as overall adoption rates remain small.¹⁶⁵ Given their success, it is useful to understand some of the practical limitations:

- As yet, there is no sound, comprehensive guidance on where and what nitrogen-fixing crops are likely to help rather than hurt. Although nitrogen-fixing trees can increase yields, in some places, trees can also *decrease* yields through competition for water and air. And the technique may need to vary significantly for different crops. For example, while many

¹⁶⁴ For good overall summaries, see F. Place, O. Ajayi, E. Masters (2011), *Tree-based and Other Land Management Technologies for Landscape Restoration in Africa: Background Paper for the investment Forum on Mobilizing Private Investment in Trees and Landscape Restoration*, World Agroforestry Center, Nairobi; D. Garity, A. Okono, M. Grayson, S. Parrott (eds.) (2006), *World Agroforestry into the Future* (World Agroforestry Center, Nairobi).

¹⁶⁵ S. Franzel, G.L. Denning, J.P. Liles-Barnekow, "Scaling up the impact of agroforestry: Lessons from three sites in Africa and Asia," *Agroforestry Systems* 61-62:329-344; O.C. Ajayi, F. Place, F.K Akinnifesi, G Sileshi, (2011), "Fertilizer tree systems in Southern Africa (Malawi, Tanzania, Mozambique, Zambia and Zimbabwe)," *Int. J. Ag. Sust.* 9(1), 129– 136; F. Place, S. Franzel, Q. Noordin, B. Jama (2003), *Improved Fallows in Kenya: History, Farmer Practice, and Impacts*, EPTD Discussion Paper 115, IFPRI, Washington, DC.

studies find yield gains from some uses of leguminous trees,¹⁶⁶ other studies have found that the use of trees during the fallow phase of rotational agriculture in Central and Western Africa did not increase yields and was inferior to the planting of herbaceous plants.¹⁶⁷

- Planting and managing trees for any of the various purposes requires a great deal more work. Trees must be pruned and leaves mulched to generate benefits from many luminous tree inter-plantings. Contrary to the thinking of many, labor is not in abundant supply on African farms because of their low reliance on machinery. In many cases, also, the benefits of agroforestry are delayed as it takes a few years for soil fertility to grow enough to yield benefits. Particularly in times of hardship, these conditions can make it difficult for farmers to pursue agroforestry techniques.
- Seedling supply is limited and may require farmers to travel many miles. Projects to expand use of trees must therefore develop many nurseries for seedlings, which means projects must have sufficient scale to work.

Because many of these practices are new and not without nuance, Africa's general lack of extension agents makes it hard to spread the knowledge and to learn and improve from experience.

Rewards for carbon gains could help justify the funding to overcome these limitations but also help to explain why reliance on the offset model may be difficult. The amount of carbon sequestered by these practices will vary significantly. For example,

¹⁶⁶ W. Makumba et. al. (2006), "The long-term effects of a gliricidia-maize intercropping system in Southern Malawi, on gliricidia and maize yields, and soil properties," *Agriculture Ecosystems and Environment* 116:85-92; E.K. Asaah et al. (2011), "Trees, agroforestry and multifunctional agriculture in Cameroon," *Int. J. Ag. Sust.* 9:110-119.

¹⁶⁷ S. Hauser, C. Nolan, R.J. Carsky (2007), "What role can planted fallows play in the humid and sub-humid zone of West and Central Africa," in A Bationo (eds) *Advances in Integrated Soil Fertility Management in sub-Saharan Africa: Challenges and Opportunities* pp. 647-668.

if fruit or nut trees are planted, there may be a semi-permanent gain in carbon, and it may be substantial per hectare. In other systems, where the trees are plowed up or form part of an eventually shifting landscape, the sustained gains are in the soil and are lower and variable. For these reasons, a high degree of aggregation among farms would be required to recognize and reward the carbon gains through offset payments, and the reduced assurance of permanence, variability, and risk probably mean a high discounting of the carbon gains by the market.

Adding carbon to agricultural lands through agroforestry is unlikely to do a great deal to offset emissions, but the indirect effects could be important.

As a direct greenhouse gas mitigation strategy, adding carbon to agricultural lands through agroforestry is unlikely to do a great deal to offset emissions, but the indirect effects could be important. For example, one review summarized the soil effects of using trees in fallow periods to fertilize soils at two to twelve tons of carbon per hectare (equivalent to 7.5 to 44 tons of carbon dioxide).¹⁶⁸ Assuming an average of 18 tons of carbon dioxide, that would be worth \$900 per hectare at \$50 per ton of carbon dioxide, enough to justify global investment to help farmers employ these practices. The added value then derives from the contributions of agroforestry to farm incomes and to food production, and to the potential benefits of the yield gains to protecting forests.

In the most deficient soils, improving farming techniques to increase yields should similarly increase soil carbon whether yield gains occur through better water management, improved seeds, or better fertilization. Yet these gains are likely to be sufficiently slow and reversible to be harder to prove. That gives agroforestry a logistical advantage for pure carbon funding. Even so, policymakers need to recognize the potential for synergistic gains and to design funding systems to encourage legitimate carbon sequestration measures whether or not they fit well into markets for carbon offsets.

¹⁶⁸ S.J. Kandji et al. (2006), "Opportunities for linking climate change adaptation and mitigation through agroforestry systems," in Garity, D. et al. (eds), *World Agroforestry into the Future*, World Agroforestry Centre, Nairobi pp. 113-123.

International Cooperation to Boost Productivity, Mitigate Emissions, and Preserve Forests

To take advantage of the opportunities to address food security and climate goals together, governments need to agree upon and support a shared vision for African agriculture. That vision should include strong productivity gains, a focus on those techniques that also reduce production emissions, limiting export agriculture to high value crops, protecting forests, and prioritizing use of African farmland to boost production of staple foods.

That vision in turn should receive financial support. At the Copenhagen climate change meeting in 2009, developed countries pledged to provide \$100 billion to developing countries for adaptation, mitigation, and general low carbon development. Challenges in coming through with these funds include the large budget deficits of U.S. and European governments, the ongoing recession, and declining political support for addressing climate change in the United States. Yet progress is ongoing among international groups appointed to help figure out the sources of funding, which could include international sources such as taxes on international shipping. Over the longer term, the imperatives of climate change will force action, and these funding commitments will probably be honored. The opportunities to provide funding for these efforts generally fit under two separate categories with their own acronyms — REDD and NAMAs — but the best opportunity lies in making them work together.

Reduced Emissions from Deforestation and Degradation

Compensating African countries for reducing deforestation below historical rates alone will not match the potential economic benefits of deforestation going forward.

Reduced Emissions from Deforestation and Degradation (REDD) refers broadly to the plans for developed countries to compensate developing countries for the economic gains they forego by protecting their forests. Funds count toward the broader \$100 billion commitment, and the climate change conference in Cancún in 2010 endorsed a general agreement to move ahead. In the first stage, countries are supposed to develop “readiness plans” that require a range of technical preparations.

Many of the critical decisions about how to implement REDD have not yet been made, and several of them will play a particularly important role in determining REDD's success in Africa. Overall, the principle behind REDD is that countries will receive compensation for holding deforestation below "reference levels," but a critical question is how to set the reference levels. For the most part, the thinking has been to focus on historical rates. In many countries in Africa, however, poor productivity and infrastructure, and political instability have led to low forest conversion rates. Compensating African countries for reducing deforestation below historical rates alone will not match the potential economic benefits of deforestation going forward. An alternative methodology will be necessary.

A second question concerns timing. Some proposals contemplate five-year REDD contracts, leaving countries free to open up their forests after that period. If Africa is able to improve productivity, the profitability of conversion will only rise. Longer-term deals will probably be required to assure that funding meets the goals.

Two other questions provide a welcome opportunity for linking REDD with productivity enhancements. How much money will countries receive for carbon savings, and who will receive it? Supporting REDD by providing funds to promote agricultural yield gains provides a potential funding source to farmers who would have less access to new land and help lower food costs to benefit consumers. Generating more food on existing farmland also helps to reduce leakage — the shifting of deforestation to other countries to provide the food needed worldwide if one country protects its forests.

Nationally Appropriate Mitigation Activities

As part of the deal at the Copenhagen climate conference, developing countries were required to submit a list of Nationally Appropriate Mitigation Activities (NAMAs) by early 2010, which, in effect, represented ways of limiting emissions while boosting development. Although developing countries are supposed to pursue these on their own as well, this list is supposed to frame areas for funding by developed countries. Many developing countries listed agricultural practices among their NAMAs, but nearly all in a very general way.

NAMAs provide a framework for developed countries to support the synergistic approaches to agriculture described above. That includes both the efforts to limit production emissions and the efforts to boost productivity while protecting forests. When countries simultaneously pursue productivity gains while protecting forests, those productivity gains themselves become carbon saving and merit financial support, and for this reason, NAMA funds could combine with REDD funding to support such joint efforts.

Trade

As both the United States and European Union continue to reappraise and reconfigure their trade preference programs for developing countries, they have an opportunity to add additional preferential access provisions for countries that achieve a certain level of forest protection. A system of rewards could also be attempted at a more global level as the member countries of the World Trade Organization continue to seek an “early harvest” of possible wins — especially for Least Developed Countries (LDCs) — from the increasingly moribund ten-year-old Doha Round of multilateral trade negotiations at the WTO. Proposals for “green tariffs” have met considerable resistance among developing countries, viewed as traditional protectionism in disguise. But “green preferences” ought to be much more palatable, and would line up with existing proposals for the removal of international barriers to the spread of green technologies.

Private Incentives

Rewards for countries that protect forests could extend beyond direct financial aid. Many private companies are also seeking to “green” their supplies. Publication of the record of countries protecting forests, combined with origin of supply labeling, could encourage consumers to purchase products from these countries.

Mechanics of Moving Forward

To a large extent, these opportunities for synergies have either escaped the thinking of those focused on providing climate funding or received little emphasis. Even REDD planning has generally

paid little attention to the complex ways in which agricultural productivity gains could support or undermine forest protection. Ultimately, for real money to flow, real people have to make real decisions about what merits funding support. Inertia and uncertainty become powerful forces in allocating funds. Developed nations are unlikely to provide funding for NAMAs without a great deal more detail. Although the synergistic opportunities are real, a variety of details will determine their effectiveness in different locations and with different farm types. For policymakers in both developed and developing countries to realize the synergies set forth in this paper, several specific actions are needed.

Ultimately, for real money to flow, real people have to make real decisions about what merits funding support.

- First, the technical opportunities need to be stated at a sufficient level of detail that countries, extension agents, and farmers can act upon them. That means developing a more detailed assessment of the practical technical opportunities and likely emissions reductions by different farming systems. Ideally, this guidance should represent the best thinking and enjoy the credibility of a distinguished international group of scientists. Princeton University and the German Marshall Fund have organized a group of 20 institutions worldwide, including leading research coalitions in Africa, to develop such guidance — although they are still seeking funding.
- Second, countries or regional groups within countries need to use this guidance to develop specific agricultural development plans for funding.
- Third, an ongoing technical group, preferably international but with African leadership, should help to assess and coordinate work on such efforts. Actually carrying out the policies will both identify a range of specific technical questions that need answering (such as how does a particular variation of SRI affect emissions and yields on a particular soil class), and generate information that can be shared across farming groups and areas.

Conclusion

African agriculture faces a set of interconnected challenges: boosting food production, adapting to climate change, protecting forests, and holding down emissions. Real synergies exist in the measures to address these challenges, but they require nuanced, scientifically-supported implementation. Political conferences have started to discuss the issues together, and projects are underway to test solutions. These efforts need to gel into a coordinated effort that combines high profile attention with the determined, detailed attention of scientists, agricultural officials, and farmers themselves.

3. Brazil and African Agriculture: Lessons from Brazilian Experience, Prospects for Cooperation

Elisio Contini and Geraldo B. Martha, Jr.

By 2050, world food demand will increase 50 percent above 2009 levels in response to per-capita income growth, increases in population, and urbanization.¹⁶⁹ Increasing the food supply will be especially important in Africa, where food demand in 2050 will vary from 115 percent to 133 percent above 2009 levels. As demand for food grows, supply must keep pace — otherwise food prices will increase. And in a situation of food shortage it is the poor, especially in poor nations, who will feel most of the burden of high food prices, since they spend a larger share of their earnings on food.

In spite of the distortions to agricultural prices — subsidies in rich countries and taxes and tariffs in poor and developing countries — the sharp downward trend in world agricultural prices in the last six decades is strong evidence that hunger has been progressively reduced.¹⁷⁰ However, food prices began a markedly different (upward) trend, in 2006, peaking in mid-2008. The number of

¹⁶⁹ G.B. Martha, Jr.'s calculation based on data from UNPD (United Nations Population Division. World population prospects: the 2008 revision, United Nations, New York, 2010, vol. 1, Comprehensive tables) and PWC (PWC. The world in 2050 – the accelerating shift of a global economic power: challenges and opportunities, www.pwc.co.uk/economics, 2011). Constant food prices and yearly growth in per capita consumption from 0.2 percent to 0.4 percent was assumed.

¹⁷⁰ Indeed, the average daily calories available for human consumption was kept more or less in balance, from 1,650 to 2,000 kcal, from the 17th century up to mid-19th century, and then 2,000 kcal per capita was more consistently achieved in the 1960s. In the mid-1990s, the average availability was around 2,600 kcal. In the 1960s, 56 percent of the human population lived with less than 2,200 kcal/day; this share decreased to around 10-15 percent in the 1990s. See, Johnson, D.G. 2000. "Population, food and knowledge." *The American Economic Review*, v.90, p1-13, and, Alexandratos, N. 1999. World food and agriculture: outlook for the medium and longer term. Proceedings of the National Academy of Sciences, v.96, pp. 5909-5914.

hungry people in the world also increased, and peaked in 2009 at 1 billion people for the first time in human history.¹⁷¹

In the wake of the 2008 financial and economic crisis, food prices rapidly decreased, although even in the depths of the worst global economic downturn since the Great Depression, they remained high compared to historical averages. Food security in poor countries was not significantly improved by the temporary respite.¹⁷² In fact the situation worsened again by the end of 2010, with another food price spike of the same order of magnitude as the one observed in 2007-2008. Recent estimates suggest that since June 2010, an additional 44 million people fell below the poverty line of \$1.25 per day as a result of higher food prices.¹⁷³ In March 2011, agricultural prices declined slightly, but is too early to say if prices will continue to fall in the longer run in a return to historical patterns.¹⁷⁴ In Africa, where economies depend heavily on agriculture and hunger is on the rise, threatening social unrest,

¹⁷¹ Briefly, factors explaining this higher equilibrium price reflected both significant structural changes in supply and demand relationships and short-term shocks to global supply and demand for agricultural products. Structural factors included slower growth in production and more rapid growth in demand. Short-term factors that have further tightened world markets included increased agricultural costs of production (and rising energy prices), low food stocks, adverse weather conditions in 2006 and 2007 in some major grain and oilseed-producing areas, increased global demand for biofuels feedstocks, the declining value of the U.S. dollar, and some country-specific food policies aiming to control food price inflation. See, Trostle, R. 2008. "Global Agricultural Supply and Demand: Factors Contributing to the Recent Increase in Food Commodity Prices." Economic Research Service/USDA Report WRS-0801, Washington-DC, 30p, and FAO. 2009. More people than ever are victims of hunger: see www.fao.org.

¹⁷² The global economic slowdown hit poor countries through both financial and commercial channels, and this importantly influenced food security and economic growth in poor countries. In part this was due to the fact that the mechanisms that are normally used by households to cope with economic shocks were to a great extent already exhausted by the preceding global food price crisis. The main transmission channels are foreign direct investment, remittances, official development assistance, financial markets, and international trade. Also, instruments generally used in regional/country crises (e.g. currency devaluation, borrowing or increased use of official assistance) are of more limited utility in the case of a global crisis. Finally, countries more financially and commercially integrated into the world economy are far more exposed to changes in international markets. See a more detailed discussion in FAO (2009), *op. cit.*

¹⁷³ World Bank. 2011a. Food Price Watch, see www.worldbank.org/foodcrisis/foodpricewatch/april_2011.htm.

¹⁷⁴ FAO. 2011. FAO Food price index, available at www.fao.org/worldfoodsituation/wfs-home/foodpricesindex/en/.

actions focused on sustainably increasing food supply in the long-term should be targeted as a high priority.¹⁷⁵

As the world looks for successful models of agricultural development in the face of the growing challenge of ensuring global food security, the development of Brazilian agriculture stands out as one of the major success stories of recent years. The transformation of traditional agriculture in Brazil into a dynamic and competitive sector at the international level — an “agricultural superpower” — in less than four decades points to some key lessons that might be helpful for efforts aimed at the future development of African agriculture and improvements in food security on the continent.

Brazil’s contribution to food security in Africa has two dimensions. The first relates to Brazil’s agricultural production and exports that benefit consumers worldwide but especially those in poor countries. The second dimension is the role of Brazil in increasing the supply of food produced in Africa through technology transfer and capacity building efforts on the ground in African countries. Opportunities for cooperation in the agricultural sector are mainly in the areas of Brazil-Africa agricultural trade — which has been steadily growing — and in the contributions of Embrapa, the Brazilian Agricultural Research Corporation, which has been particularly active in providing technical assistance and extension services to African agriculture.

A Brief Overview of the Development of Brazilian Agriculture

In the early 1950s, the Brazilian government adopted an economic policy of industrialization based on import substitution. Until the mid-1980s, the industrial sector in Brazil was granted a

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¹⁷⁵ In addition, low-income and middle-income countries are experiencing on average 5 percent higher food price inflation compared to better-off countries. In several African countries, double-digit increases in food prices were recorded during the first quarter of 2011 (World Bank, 2011, *op.cit.*).

series of advantages over agriculture. The policy was based on an overvalued foreign exchange rate to favor capital goods imports and prevent the imports of other goods, and subsidized interest rates on loans to the capital goods industry. Economic policy also promoted consumer goods imports and investments in energy and transportation infrastructure. Food prices were kept artificially low to avoid wage inflation through pressure on urban salaries. The government's priorities were urban infrastructure, investments in housing and health, and safeguarding wages.¹⁷⁶

In the early 1970s, Brazil — with the rest of the world — faced a food supply crisis that resulted in increased food prices. At the same time, rural-to-urban migration had been intensifying as workers were drawn to better wages in the cities, a consequence of the growing industrialization taking place in the country. At that point, opportunities for agribusiness exports were identified as a means to generate funds to finance imports of technology and capital assets for the emerging industrial sector. At the same time, it became clear that the opportunities for agricultural expansion in traditional areas were limited. Increasing productivity in already cultivated areas and incorporating the “unproductive” Cerrado — the savanna-like biome in Brazil — was seen as a means to guarantee increased agricultural production and a steady supply of food to the growing urban population at affordable prices. Thus it was necessary to improve land and labor productivity in agriculture significantly. This required a strategy to transform traditional agriculture into a modern, vigorous, and dynamic sector based on scientific advances.¹⁷⁷

The Brazilian Government responded to the challenge of heading off a food crisis and creating a new era in agriculture based on emerging opportunities for a restructured and vibrant agribusiness sector with a decisive act: the creation in 1973 of Embrapa, the Brazilian Agricultural Research Corporation and research arm of the Ministry of Agriculture, with a national mandate to generate and distribute new technologies for use by the farm sector. At its inception, Embrapa was founded on two pillars: a *focused research*

¹⁷⁶ Contini, E., Gasques, J.G., Alves, E., Bastos, E.T. 2011. “The dynamism of Brazilian agriculture.” *Revista de Política Agrícola* [Agricultural Policy Journal, Brazil] (in press).

¹⁷⁷ Martha, Jr., G.B., Contini, E., Alves, E. “Embrapa: its origins and change.” In: Baer, W., Aman, E., Coes, D. (Eds.) *Regional Impacts of national policies in Brazil*. (forthcoming).

model, concentrated on products and areas of fundamental importance for the development of the country's agriculture, and *human resource capacity building*, based on strong training programs in centers of excellence around the world. Additionally, Embrapa was assigned to coordinate the Brazilian agricultural research system, composed of state agricultural research organizations, universities (agricultural colleges), and Embrapa itself.

The steady stream of technologies developed by Embrapa, state agricultural research organizations, universities, and other public and private partners, coupled with supportive public policies and the strong backing of the farmers, have made it possible for Brazil to develop into a powerhouse of global agriculture. From 1975 to 2011,¹⁷⁸ grain and oilseed productivity rose 151 percent and production grew 228 percent, while crop land area increased only 31 percent. Sugarcane production increased steadily from 89 million tons in 1975 to 696 million in 2010.

In the period from 1978-2010, poultry, beef, and pork production rose 915 percent, 270 percent, and 201 percent, respectively.¹⁷⁹

It is worth noting that the development of Brazilian agriculture on the basis of strong productivity gains allowed for a huge land-saving effect of around 600 million hectares in the last 60 years.¹⁸⁰ This means that because of productivity gains in Brazilian agriculture in the past six decades — mainly in the last 20 years — a land-saving effect equivalent to 1.3 times the geographic area of the European Union was generated.

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¹⁷⁸ 2011 estimate.

¹⁷⁹ See, CONAB. 2011. Statistics of Brazilian Agriculture, available at www.conab.gov.br.

¹⁸⁰ As an example, consider that during the 1950-2006 period, productivity gains explained 79 percent of the growth in beef production in Brazil and supported a land-saving effect of 525 million hectares. Therefore, without this land-saving effect, an additional pasture area that is 25 percent larger than the Amazon biome in Brazil would be needed to meet current levels of Brazilian beef production (Martha, Jr., G.B., Alves, E., Contini. Land-saving technologies and beef production growth in Brazil. *Journal article in revision*). In the 1950-2006 period, Brazilian grain, oilseeds, and sugarcane production provided an additional land-saving effect of 78 million hectares (G.B. Martha Jr., *work in progress*).

The total factor productivity (TFP) of Brazilian agriculture showed a continuous upward trend in the 1970-2006 period. Compared to 1970, the TFP in the period increased 124 percent, production rose 243 percent, and inputs grew 53 percent. Gains in productivity accounted for 65 percent of the agricultural output in the 36-year period, while inputs accounted for 35 percent. In the 1996-2006 period, productivity was even more important, accounting for 68 percent of the increase in production.¹⁸¹ These figures support the view that Brazilian agriculture has developed by strongly prioritizing productivity gains and not by expanding the area of land under production.

Over the last four decades, the Brazilian domestic market has been a major beneficiary of these agricultural development outcomes. Food production has increased at higher rates than food demand over time while food prices have decreased. Food supply crises are a thing of the past, and the price for a basket of food in, for example, the city of São Paulo in February 2010 represented 50 percent, in real terms, of the cost recorded in January 1975. In 35 years, food prices for consumers have decreased by half, reflecting the great expansion of agricultural production in Brazil. Even when food prices peaked in 2008, they had a very small impact on the prices paid by consumers.

The increased food supply that resulted from technological gains throughout the period, as well as the deregulation of markets in the 1990s, led to some very important effects for society. One very important effect was a significant transfer of income from farmers to consumers. Gains for consumers took place partially due to lower income for Brazilian farmers. In the decade that followed the Real Plan in 1994, this transfer might have exceeded R\$1 trillion. Income transfer from the rural area to consumers seems to have stabilized at around R\$150 billion annually.¹⁸²

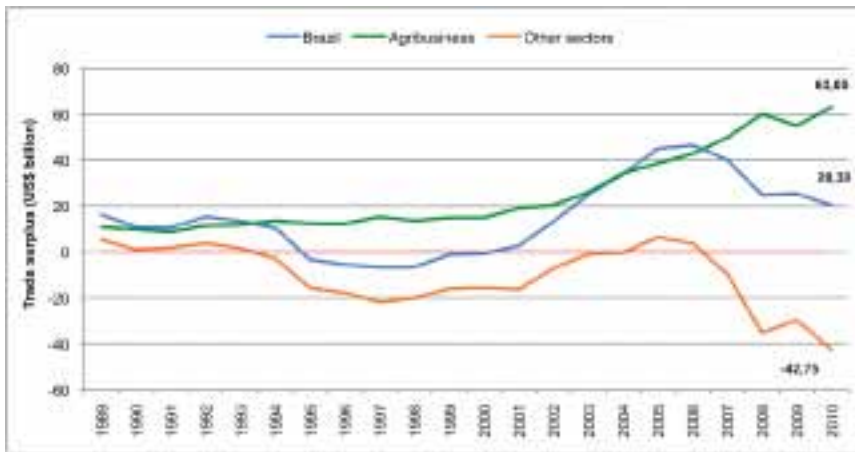
¹⁸¹ See, Gasques, J.G., Bastos, E.T., Bacchi, M.R.P., Valdes, C. 2010. "Produtividade total dos fatores e transformações da agricultura brasileira: análise dos dados dos Censos Agropecuários." In Gasques, J.G., Vieira Filho, J.E.R., Navarro, Z. (Eds.) *Agricultura Brasileira: desempenho, desafios e perspectivas*. [Brazilian agriculture: performance, challenges, and perspective]. Brasília: IPEA, p.19-44.

¹⁸² Barros, G.C.S. 2006. *Agronegócio brasileiro: perspectivas, desafios e uma agenda para seu desenvolvimento*. Piracicaba: USP/Esalq/Cepea, p. 50.

Of course, other complimentary effects are also relevant. For example, decreasing food prices resulting from an expanded supply was key to Brazilian macroeconomic stability. Following the Real Plan, agribusiness was very important to the Brazilian economy as a whole. For example, between 1995 and 2009, agribusiness accumulated a trade surplus of US\$428 billion. In the period, the Brazilian trade surplus as a whole amounted to US\$230.9 billion, representing 54 percent of the value registered for agribusiness. The lower overall trade surplus in Brazil, as compared solely to that of the agribusiness sector, reflects the fact that other sectors of the economy imported more than they exported.” (See Figure 1).

Brazil has seen dynamic agricultural export growth since the late 1990s, with diversification of the portfolio of exports and several new markets importing Brazilian agricultural products. From 2000 to 2010, agribusiness exports went from \$20 billion to \$75 billion, strongly contributing to Brazil’s balance of payments.¹⁸³

Figure 1. Evolution of trade surplus (export-imports) in Brazilian economy.



Source: Data from Secex/MDIC compiled by Agrostat-Brasil, 2011, authors' elaboration.

It is important to stress that in spite of the increased presence of Brazil as an exporter in international agricultural markets, the country’s domestic food supply has not been — and will not be — compromised. The projected share of production for export by 2019/2020 is 18 percent for corn, 46 percent for soybeans, 21-37

¹⁸³ 2010 estimate. Agrostat Brasil. 2011. Statistics of the Brazilian Ministry of Industry and Trade, Brazilian Ministry of Agriculture, Livestock and Food Supply database Agrostat-Brasil, available at www.agriculture.gov.br.

Countries are eager to know how Brazilian agriculture was transformed into one of the most competitive farm sectors in the world in a period of less than four decades.

percent for meat, and 24 percent for ethanol. Production is projected to grow 2.88 percent per year and it is expected that productivity will continue to be a major driver of increased food/feed production. Cropland area is likely to increase around 9.3 million hectares.¹⁸⁴ This area represents only 5.9 percent of the current pasture area in Brazil, indicating that land-saving effects generated by small increases in pasture productivity can easily accommodate future crop demand for land.¹⁸⁵

Brazil will thus play a more significant role in global food security in the near future. A large share of increased global food production and exports is expected to come from Brazil.¹⁸⁶ However, strengthening global agricultural markets and trade will be necessary as a means to reduce both price volatility and agricultural prices, bringing them down to levels closer to the historical pattern.

The success of Brazilian agriculture has awakened intense interest from other developing countries, mainly in Africa, Latin America, and the Caribbean. Countries in these regions are eager to know how Brazilian agriculture was transformed into one of the most competitive farm sectors in the world in a period of less than four decades. These countries also wish to know more about Embrapa's work, expertise, and experience in tropical agriculture. In the last 15 years Embrapa has been expanding its participation in international projects, broadening the possibilities for fruitful cooperation with other countries.

¹⁸⁴ Ministério da Agricultura, Pecuária e Abastecimento. 2010. Projeções do agronegócio: Brasil 2009/2010 a 2019/2020. [Agribusiness projections: Brazil 2009/2010 to 2019/2020] Brasília, Assessoria de Gestão Estratégica, 76p.

¹⁸⁵ Martha, Jr., G.B., Vilela, L. Efeito poupa-terra de sistemas de integração lavoura-pecuária. [Land-saving effects from integrated crop-livestock systems] Planaltina: Embrapa Cerrados, 2009. 4p. (Comunicado Técnico. Embrapa Cerrados, 164).

¹⁸⁶ See, Organization for Economic Cooperation and Development–Food and Agriculture Organization (OECD-FAO). 2010. Agricultural Outlook 2010-2019. (OECD-FAO, Paris).

Opportunities for Brazil-Africa Cooperation in Agriculture

Trade and Investment: Agricultural Value Chains

Brazilian trade with Africa increased significantly in the last decades, especially in the years after 2003. In 1989, Brazil-Africa trade flows (exports plus imports) was \$1.51 billion. Trade flows peaked at \$25.9 billion in 2008 but then decreased to \$17.2 billion in 2009. In 2010, trade flows increased again to \$20.56 billion, representing an annual growth rate of 13.2 percent relative to 1989. Imports to Brazil grew faster (15.5 percent) than exports (11.4 percent) in the 1989-2010 period (see Annex, Table A.1.). Raw materials and semi-processed products accounted for 79 percent of \$9,261.60 million in Brazilian exports to Africa in 2010. Agribusiness' share in Brazilian exports increased from 59 percent to 66 percent in the 1997-2010 period (Annex, Table A.1.).

Trade with Brazil is particularly relevant for six countries in Africa: South Africa, Angola, Algeria, Egypt, Morocco, and Nigeria. Historically, these countries represent 80 percent of Brazil's trade with Africa and 70-75 percent of the exports. Brazilian agribusiness exports to these countries (e.g. the percentage relative to total exports) reveal a different trend. From 1997 to 2010, the share of agribusiness exports to South Africa and Angola increased, remained constant in the case of Algeria, Egypt, and Morocco, and decreased as a share of exports to Nigeria (Annex, Table A.1.).

Considering select agricultural products exported from Brazil to Africa (e.g., soybean products, meat, sugarcane products, coffee, forestry products, and cereals), the volume traded increased 16 percent per year from \$820.29 million to \$5,633.11 million in the 1997-2010 period (Annex, Table A.2.). The share of cereals and sugarcane products exported to Africa was quite significant, representing around 23 percent of Brazilian exports of these

products. Whilst cereals represented only 3.6 percent of the value of Brazilian agribusiness exports in 2010, the share of sugarcane products exports was far more representative, in the order of 18 percent of the total value. African countries are also importing significantly more meat from Brazil. The imports increased from \$22 million, in 1997, to \$1,446 million, in 2010. In 1997, African imports represented 1.4 percent of Brazilian meat exports, but this share increased to 10.6 percent in 2010 (Annex, Table A.1.).

Brazilian Foreign Direct Investment (BFDI) in Africa between 2001 and 2008 added up to \$1,120.77 million; in 2008, three countries — Angola, South Africa, and Mozambique — accounted for 94 percent of BFDI in Africa.¹⁸⁷ Whilst basic infrastructure and capital and social investments are obviously important to generating a virtuous cycle of development, a serious barrier to increasing the production capacity of the agricultural sector, and one that requires time to be removed, is human capital. The Brazilian government, especially in the last five years, has been investing heavily in this dimension, through cooperation projects and capacity-building activities. Embrapa's agenda with Africa is an example.

*Embrapa's Initiatives in Africa*¹⁸⁸

Embrapa's international outreach is conducted in conformity with governmental foreign policy guidelines, and can be divided into two broad strategies. The first aims at incorporating knowledge and technologies into the Brazilian agricultural sector, which involves centers of excellence in training in developed countries, technical visits, and, more recently, Embrapa's Virtual Laboratories Abroad (Labex), whose purpose is to perform cutting-edge research in partner laboratories overseas and to monitor scientific and technological developments in the region in which they are located.

The second strategy consists of technology transfer as humanitarian aid to poor and friendly countries, with a special

¹⁸⁷ See, Földes, S. The Financing of Brazilian Companies in Africa: the role of BNDES (Brazilian Development Bank). Cebri ("Brazilian Center of International Relations") Seminar, "Brazilian and Chinese Business in Africa: partnership, competition and development.

¹⁸⁸ Based on Pinheiro, B.S., Prado, A.C., Contini, E. 2011. Capacitação Internacional em agricultura tropical. Rio de Janeiro, Fundação Alexandre Gusmão. (in press). Embrapa Estudos e Capacitação. 2011. Organizando e Disseminando o Conhecimento. Brasília, Embrapa Estudos e Capacitação (unpublished). Sotero, P. Brazil as an Emerging Donor. Development Outreach, Especial Report. World Bank Institute (no date).

focus on promoting food security for their populations. For decades, Brazil was a recipient of technical and scientific support for the development of its agriculture. In recent years, from an original position as recipient, Brazil has become a significant donor of technical assistance, particularly in tropical technology, due to the progress obtained in agricultural production in the Cerrado. In addition to political and commercial interests, Brazil's recent progress in terms of economic, social, and political development has given the country new responsibilities in the community of nations.

In recent years, from an original position as recipient, Brazil has become a significant donor of technical assistance, particularly in tropical technology.

In past decades, Embrapa's activity in Africa focused on specific cooperation projects for technology transfer on specific products, at the request of the governments concerned. Embrapa would also offer training courses for professionals from African countries in their research centers, with funding from international agencies or from foreign governments. In 2006, by order of President Lula de Silva, a new stage of cooperation with Africa was initiated with the installation of an office in Ghana, the purpose of which is to provide greater coordination to Embrapa's activities in the African continent. This new strategy stems from a political decision taken at the highest levels of the Brazilian government.

President Lula's enthusiasm for and conviction about Embrapa's ability to transfer technologies to improve food security has attracted the leaders — presidents, ministers, and other government executives — of a number of African countries to Brazil to learn about the transformation of Brazilian agriculture. In the course of such visits, new demands arise for assistance in the creation of agricultural research institutions in those countries and for new cooperation projects. Close collaboration with the Ministry of External Relations (MRE — Ministério das Relações Exteriores), and especially financing from the Brazilian Cooperation Agency (ABC — Agência Brasileira de Cooperação) facilitates missions and the implementation of cooperation projects with African countries.

To meet such growing demands, Embrapa has reorganized its international cooperation activities, creating a framework for long-

term “structuring projects” — which have more resources and last longer — aimed at better results. Embrapa selects senior researchers to manage activities under such “structuring projects” in those countries. This reorganization marked the beginning of a series of tripartite projects, in which, in addition to the African country and ABC and Embrapa in Brazil, a third, developed country — the United States, Japan, France, etc — is also involved, as is the case in three projects with Mozambique. In late 2010, Embrapa had a total of 38 projects that were either being implemented or were under final negotiation with 16 African countries. The total resources devoted to these projects amounted to \$16.2 million, out of which nearly \$9 million was provided by the Brazilian government.

Among Embrapa’s 38 projects in Africa, four of the “structuring projects” are particularly noteworthy. The Cotton Sector Development Support Program in the “Cotton-4” countries — Benin, Burkina Faso, Chad, and Mali — has \$4.7 million in funding from ABC and aims to raise crop productivity and increase the competitiveness of the cotton production chain in West Africa. It also provides training programs for researchers and technicians from the four African countries concerned.

Another project, in support of the development of the rice industry, provides for investments in physical infrastructure for the implementation of pilot participatory research units, aiming at the selection of rice cultivars and at seed production. Two other infrastructure projects are being implemented in Mozambique: a Japan-Brazil Partnership Program (JBPP) for the development of agriculture in the tropical Savannas of Mozambique and a USAID-ABC-Embrapa trilateral cooperation project with Mozambique to improve the production and distribution of vegetables and the quality of school meals. These projects qualify as North-South-South cooperation, and marshal the resources and experience of developed country governments coupled with Embrapa’s technical and scientific capacity in tropical agriculture. They are broad-scope initiatives that involve, in addition to ABC and Embrapa, two major international cooperation agencies — JICA from Japan and USAID from the United States.

Embrapa is also collaborating with the government of Angola in a project in support of the restructuring of the national agricultural

research system of the Ministry of Agriculture of Angola. Embrapa researchers have collaborated with Angola in defining the location and basic structure of the National Agricultural Research Centers in Angola covering the production of maize and beans, manioc, sweet potato and peanuts, goats and sheep, and dairy cattle.

Another important area of collaboration for the Brazilian government via Embrapa and ABC is the training of researchers and agricultural professionals from African countries. Through the course of 2008 and 2009, 250 technicians from 16 African countries were trained in 15 Embrapa research centers. The areas of training were conservation agriculture, bioenergy and biofuels, cultivation and agro-industrial processing of manioc, institution-strengthening, vegetables and fruit crops (tropical fruit and cashew), dairy and beef cattle, goats and sheep, production and use of genetically modified varieties, forestry crop regeneration and breeding, and technologies for grain and oilseed production.

To strengthen the training of professionals in tropical agriculture in developing countries, including Africa, as proposed by President Lula, in 2010 Embrapa created the Center for Strategic Studies and Capacity-Building on Tropical Agriculture, which is also known as Embrapa Studies and Training. In that same year, 125 African professionals were trained in issues related to improving food security in forage crops and pastures for beef cattle, seed production, soybean crops, and family farming (seeds, water conservation). In 2011 there were courses on soybean production and community maize production for 75 African technicians. For 2012, there is a plan for the training of 80 professionals from Mozambique in agricultural research management and transfer.

In summary, in the last decade, Embrapa's activities in Africa have intensified and focused on the transfer of technologies on tropical agriculture and on support for the creation of agricultural and livestock research organizations. With ABC's support, they included visits by African scientists to Brazil and cooperation projects in poor African countries. Four "structuring projects" with

Higher economic growth will drive demand for food and also demand for energy. In addition, changes in consumption habits associated with urbanization will further increase food demand.

the long-term presence of senior researchers were initiated in African countries, and a strong training program is being carried out by Embrapa Studies and Training. All these activities have support at the highest political level of the federal government of Brazil.

Future Prospects

Several African countries reestablished their economic growth paths in the last decade. In sub-Saharan Africa overall, the GDP growth rate increased from 2.30 percent in 1991-2000 to 4.77 percent in the last decade (2001-2009).¹⁸⁹ Higher economic growth will drive demand for food with high income elasticity (meat, dairy products, legumes, vegetables, fruits), and also demand for energy. In addition, changes in consumption habits associated with urbanization will further increase food demand. Per capita income in cities is usually higher compared to rural areas and urban diets have in general diversified from the traditional staples to include animal protein, legumes and vegetables, and fruits. This scenario will further reinforce the need for increased agricultural production in Africa in order to avoid food insecurity and macroeconomic and social problems.

Taking Brazil as an example, three factors determine the production potential of agriculture: human capital, technology generation and diffusion, and natural resources and weather conditions. Given the availability of these factors, certain conditions can favor agricultural production capacity, both in terms of intensity and timely response in supply. Good examples are economic issues favoring the increase in supply and sound policies at the sectoral and macroeconomic levels. On the other hand, certain conditions can have negative effects by restricting agricultural production capacity. Examples include a lack of adequate infrastructure for the transport and distribution of agricultural products from the farm to the market and then to consumers; a lack of communications and information technology; legal and regulatory problems (labor legislation, environmental issues); economic policy issues (interest

¹⁸⁹ World Bank. 2011b. World Bank Database, available at www.worldbank.org/data.

rates, taxation); and administrative efficiency (bureaucracy, barriers to exports).¹⁹⁰

The African continent has more than 50 countries with a high degree of agro-ecological, political, and cultural heterogeneity. Social fragmentation is occurring in many instances, and, overall, one major observation is that locally and regionally specific approaches to agricultural development, agriculture-led growth, and food security will be necessary. Of course, political and macroeconomic stability are conditions for allowing agriculture to provide aggregate economic growth with spillover effects in social and environmental terms as well.

The empirical and historical evidence is overwhelming that agriculture is a powerful and essential tool for fostering economic and social development, particularly in early stages of development when industrial and services sectors are not well established. By removing some technical and political constraints, Africa would benefit from such a strategy as well. With a few exceptions — for example, countries with significant resource endowments such as oil — countries have to rely heavily on agriculture at initial stages of development to generate a virtuous cycle of growth and development.

Real opportunities exist to promote development in Africa through agriculture, and in fact agricultural growth is essential for GDP growth in much of the continent, for a number of reasons. First, agriculture is a large sector in African countries so growth in the sector has a significant weight in aggregate growth. Second, agriculture has large growth multiplier effects on other sectors of the economy — in the case of Africa, these multipliers are estimated at 1.3 to 1.5, meaning that an additional \$1 of value added in African agriculture generates 30 to 50 cents in nonagriculture. And agricultural multipliers are far larger than the reverse multipliers of

Political and macroeconomic stability are conditions for allowing agriculture to provide aggregate economic growth with spillover effects in social and environmental terms as well.

¹⁹⁰ Martha, Jr., G.B., Alves, E., Contini, E., Ramos, S. The development style of Brazilian agriculture and future challenges. *Revista de Política Agrícola [Agricultural Policy Journal, Brazil]* (in press).

nonagriculture on agriculture. Third, agriculture and agro-industry are sources of competitive advantage for African economies due to the availability of natural resources and unskilled labor, the relatively low cost of investment in agriculture and agro-industry compared to other more sophisticated manufacturing sectors, and the poor infrastructure and lack of legal and financial services and regulatory institutions. Finally, there are real limitations on the tradability of food.¹⁹¹

In conclusion, the experience of Brazil's agricultural transformation is proof that it is possible to have an efficient and competitive agriculture in the tropics. The key-factors that contributed to this achievement were: 1) the entrepreneurship of farmers; 2) the commitment of the government to agriculture;¹⁹² 3) the availability of basic infrastructure; 4) favorable weather conditions; 5) the large extension of arable lands; 6) the suitability of the landscape for mechanization; 7) good physical characteristics of the soils, namely in the savanna region; 8) availability of mineral resources (limestone and phosphate); and, 9) science-based tropical agriculture. Most of these factors that transformed Brazil into an agricultural superpower are also present in many African countries, albeit to differing degrees.

¹⁹¹ See, for example, World Bank. 2007. World Development Report: Agriculture for development, Washington, World Bank. 365p., and, Janvry, A., Sadoulet, E. 2010. "Agriculture for development in Africa: business-as-usual or new departures?" *Journal of African Economies*, v.19, Suppl.2, ii7-ii39.

¹⁹² Three policy instruments were key: 1) subsidized financial credit, for modern inputs purchase and capital financing; 2) investments in science and technology (Embrapa, the State's agricultural research system and the colleges of agriculture); and, 3) rural extension. See, for example, Contini et al. (2011) *op.cit.*

Conclusion

Joe Guinan

The unprecedented level of international public attention and political commitment to tackling the problem of food insecurity in the wake of recent global food crises reflects a widespread recognition of the humanitarian and geostrategic importance of food production and agricultural development in a rapidly changing world. Last year, the political upheavals of the Arab Spring — in which the rising cost of food served as a trigger — and the desperate mass migration in the face of famine in the Horn of Africa kept food security issues on the front pages of newspapers and at the top of the international policy agenda. The level of political attention and resources presently being devoted to global food security have created a new policy and business environment that provides a window for fundamental changes of approach on the part of governments, donors, and the private sector — a once-in-a-generation opportunity.

A number of significant initiatives are well underway at the bilateral, regional, and multilateral levels, and they are worthy of support. However, critical elements are missing without which these efforts will struggle to achieve success. Current approaches risk falling into silos, with a clear need to better integrate nutrition, agricultural productivity, and environmental sustainability — especially with regard to climate change. Without chasing the elusive grail of “donor coordination,” efforts to promote food security in Africa must be better aligned and capable of drawing upon the strengths of a broader array of donors, including emerging economies like Brazil, in new forms of partnership. And above all, the resources of the private sector must be mobilized.

This report has suggested three principal ways in which ongoing initiatives to promote food security can be adjusted, augmented and leveraged to increase their reach and impact. They represent the *who*, *what*, and *how* of a renewed international effort to promote food security and agricultural development in Africa that will have an increased likelihood of success.

Increased coordination to mobilize the agricultural potential of this region and spur agricultural production and trade in Africa would represent a huge contribution.

In terms of *who*, the circle must be expanded beyond traditional donors to recognize the current and future contributions of a broader array of players — especially Brazil. Initiatives on the part of the United States and European countries have been widely discussed, including the role of the G8, but the 21st century global economy — and especially the 21st century global *agricultural* economy — contains of a host of other actors from the wider Atlantic Basin and beyond. Investors

from Asia and the Persian Gulf have been major protagonists in the “land grab” phenomenon in Africa. China is of course the elephant — or rather, the dragon — in the room, but the role of China in Africa is complex and poses a challenge to increased coordination, cooperation, and alignment for a number of reasons, including political considerations. But the role of emerging powers from the Atlantic Basin region such as Brazil should be far less problematic. Increased coordination to mobilize the agricultural potential of this region — in terms of the available natural resources, land, labor, capital, technology, and maritime and trade relations — and spur agricultural production and trade in Africa would represent a huge contribution.

The U.S. Feed the Future initiative explicitly foresees a role for Brazil as a “strategic partner” in the initiative, although little attention has thus far been given to what precisely this role should mean. Brazil — as Elisio Contini and Geraldo Martha have shown — is already very active in Africa as a trading partner, donor, and provider of agricultural technology and technical assistance. Political backing for this engagement is presently at the highest levels in both Africa and Brazil, as can be seen in the opening by Brazil of agricultural research laboratories across Africa together with the launch of the “Brazil-Africa Dialogue on Food Security, Fighting Hunger and Rural Development.” When he was president of Brazil, Lula spoke of the country’s “historic debt to Africa,” and during his time in office, he visited 26 African countries and opened 16 new embassies on the continent. Importantly, Lula blazed a trail on food security at home, halving the proportion of hungry people and reducing poverty rates through the “Zero Hunger” program. These successes were recognized in October

2011 when he was one of the 2011 World Food Prize laureates. This role for Brazil as donor, trading partner, and model should be amplified and encouraged beyond the natural boundaries of Lusophone Africa. The tripartite projects described in Chapter Three above — in which Brazil partners with a third, developed country such as the United States or France in order to finance Embrapa projects on the ground in African countries — are particularly promising and may offer one path to addressing the problem of donor fragmentation. However, given that they totaled only \$16 million at the end of 2010, they are ripe for replication and scaling up.

In terms of *what*, the linkages to climate change and the importance of regional markets in Africa are clearly in need of further attention in existing initiatives. We do not have the luxury of two African agricultural systems, one for food supply and the other for climate change mitigation, and so a single system must serve the needs of both improved food security and reduced emissions. Thankfully, as Tim Searchinger argues, increases in agricultural productivity provide the principal mechanism for both. There are still tensions to be worked out regarding the incentives for extension of agricultural production onto new lands, particularly forests, as well as the environmental implications of intensification. As is often the case, the devil will reside in the technical details. But there can be no doubt that the opportunities for synergies between climate mitigation and adaptation efforts and food security initiatives through increased agricultural productivity represent the most practical and economical pathways for making progress on both. Much greater attention must be given to the technical issues of implementation and how agriculture can be incorporated into national climate change mitigation strategies through a broadly endorsed and operationally specific set of technical guidelines backed by real resources.

To his credit, Tim Searchinger has already begun this work via his Agricultural Synergies Project, in which a worldwide network of research institutions has come together to develop specific technical guidance for

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scientifically robust ways of boosting food security while holding down emissions. The focus is on practical steps countries can take now even as important research goes into developing additional techniques for the future. But this project is still in its initial stages, and a lot more is needed in terms of both scientific work and financial resources. There are also tensions with other strategies to promote agricultural development and food security which will need to be worked out. An obvious one is with the promotion of increased trade. Searchinger suggests that, from an emissions standpoint, efforts to boost export agriculture in Africa should focus on high value, labor-intensive crops, such as fruits and vegetables, coffee and cocoa, spices, and flowers

Country ownership in food security initiatives should not be completely synonymous with government ownership.

On the need to build Africa's regional markets, donor-funded food security initiatives to date have had a strong focus on "country ownership" — understandably, given the Paris Declaration on Aid Effectiveness. But once again, there are tensions to be worked out, in this instance with the imperative for regional economic integration in Africa. Country ownership in food security initiatives should not be completely synonymous with *government ownership*, and more must be done to incorporate a broader range of stakeholders, including civil society and the private sector. Addressing the real-world needs of agribusinesses will be critical to building functional regional markets.

As Katrin Kuhlmann argues, the "Development Corridors" offer the most promising framework around which to align resources in support of regional integration in Africa. Initially proposed by Nelson Mandela when he was president of South Africa, the Corridors have developed significant support among African organizations concerned with trade, such as the Regional Economic Communities (RECs) and the Comprehensive Africa Agriculture Development Programme (CAADP). But they need significant additional investment and effective management to balance the needs of businesses of all sizes. In particular, they need to be made more supportive of agriculture and given governance structures that can ensure effective coordination of resources and take into account the needs of all stakeholders, small and

large. The shortcomings of early efforts by donors and groups of private companies in support of the Corridors — for example, the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) — should be addressed and the successes replicated.

Finally, in terms of *how*, it remains the case that currently pledged public funds — even if they fully materialize — are insufficient to deliver the changes necessary given the scope and scale of the food security challenge. Aside from the long-term need for investment in agricultural research and technology to boost agricultural productivity, there is an immediate need to improve access to food, largely *economic* access. The incomes of Africa's rural poor must be raised. But in sub-Saharan Africa alone, the \$2 per day poverty gap amounts to more than \$200 billion per year, the equivalent of about two-thirds of the continent's gross domestic product. In contrast, U.S. foreign aid stands at less than \$30 billion annually. In a straightened fiscal environment in which the prospect of large-scale additional resources appears doubtful, there is simply no way to fill this poverty gap with transfers. Donor funding must leverage private sector activity. There is no other way.

Ultimately, only global capital markets can finance the scale of productive investment necessary for African agriculture to deliver economy-wide benefits. But despite a rash of announcements heralding the establishment of new investment funds focused on African agriculture, to date relatively few have actually materialized. Those that have have tended to struggle with capitalization and, beyond that, with deal-flow. In terms of committed funds actually being invested, the level of activity, though growing, remains small, especially as compared to the need. The handful of private equity funds active and looking for projects delivering equity returns have by a recent count little more than \$1 billion invested overall in sub-Saharan Africa. This is less than the annual amount of new agricultural investment that one study concluded could be absorbed along the Beira Corridor in Mozambique. Currently, because of the equity-type returns required, fund managers must seek larger investments usually in existing farms typically dedicated to producing traditional export cash crops. Unless something is done to help with the creation of robust pipelines and the mitigation of risk for investments incorporating small farm agriculture, the danger is that the investors will gravitate back in the

direction of the usual investments in South Africa or Kenya and the potential for broader impact will be lost.

This issue of risk is particularly critical. Agricultural investment in Africa, especially investment that involves small farmers, is perceived as particularly risky, even by the “impact investment” community. Because of the perceived high risks associated with African agriculture and the infrastructure constraints that have confounded private investors, public sources of finance will be necessary to put in place catalytic investment. Instead of skirting the perceived risks of investing in agriculture, donors should help mitigate them by using policies and donor investment capital to encourage private sector investors to take more risks themselves and to experiment with new models. A portion of the public funds already promised for food security but sitting with donors and with the International Finance Corporation could be used to provide investment capital alongside private equity investments in agriculture and food that would mitigate risk by addressing barriers to investment and building technical capacity needed for enterprises to succeed. In addition, governments could better use tools already at their disposal such as loan guarantees, insurance, and export credit to help offset the risk investors will bear. International institutions like the World Bank could also make better use of other risk mitigation tools (e.g., crop insurance schemes) and should make sure that investors are aware of the tools that are available.

More broadly, there is the issue of improving the policy and regulatory environment in Africa. Private sector representatives consistently cite barriers to trade and investment as the most significant hurdle to increased investment in agricultural production in Africa. In the past, poor policy choices in the public sector constrained the success of both the commercial and small-farm segments of African agriculture. African governments showed a relative lack of interest in agriculture and discriminated against the sector through taxes and sometimes through deliberately obstructive government policies, especially toward the commercial sector. After decades of neglect, this has begun to change. Spurred on by favorable macroeconomic trends (and

perhaps also by increasing political pressure from the countryside) African governments have at last begun to allocate greater attention, resources, and effort to the agricultural sector. But poor governance — both corruption and ineffectiveness — has been and remains a significant problem. However, this picture, too, is beginning to change, particularly in areas with a high potential for commerce.

The World Bank's 2009 *Doing Business* report found a continuing upward trend on reform in sub-Saharan Africa:

“This focus on reform comes after several years of record economic growth in Africa. Annual growth has averaged nearly 6 percent in the past decade, thanks to better macroeconomic conditions and greater peace on the continent. With more economic opportunities, regulatory constraints on businesses have become more pressing. Governments increasingly focus on reducing these constraints.”¹⁹³

In the long run, governments will not make the right policy choices — or enforce laws to the benefit of African agriculture — unless they figure out an appropriate way to engage agricultural businesses in the policymaking process. Private sector participation can be encouraged by identifying barriers at the agribusiness and investment levels and getting institutions and government agencies to act to remove these barriers — something that will require considerable political will on the part of Africa's leaders. There is thus a pressing need to create structures to directly involve the private sector and promote integrated real-time approaches to learning and metrics, while at the same time ensuring that there is proper concern for protecting the public's resources and interests. Effective public-private partnerships in agriculture have lagged behind those in other sectors, and public officials do not always have the expertise to ensure that such partnerships are using public support for a public purpose. Developing new models for these partnerships — around the Development Corridors, around the issue of mitigating risk — should be a priority matter for immediate attention.

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¹⁹³ World Bank, *Doing Business 2009*, pp. 2-3.

There is a pressing need to create structures to directly involve the private sector and promote integrated real-time approaches to learning and metrics, while at the same time ensuring that there is proper concern for protecting the public's resources and interests.

The present moment holds out real opportunities for a transformation of African agriculture based on shifting fundamentals in the global food system and the significant commitment of public and private investment in Africa's food future. The growing interest in Africa's agricultural potential represents an enormous opportunity, but the manner in which investments occur will be critical to whether or not they lead to enhanced food security for Africa's people. This report has suggested three broad areas in which critical linkages should be made in order for current food security initiatives to play a catalytic role in this transformation. In this way the international community can help make the current moment of opportunity for African

agriculture a reality.

Annex

Table A.1.

	1989	1997	2010	1989-1997	1997-2010	1989-2010			Agriculture exports and share relative to Africa		
						%/yr.	Exports	Imports	1997, US\$	% total	2010, US\$
Africa	965,867,182	1,520,000,381	9,261,599,799	5.83%	14.91%	11.37%	896,622,661	58.99%	6,083,541,775	65.69%	
Selected	729,349,412	1,153,202,540	6,629,905,622	5.89%	14.40%	11.08%					
Selected, share (%)	75.51%	75.87%	71.58%								
South Africa	170,428,609	331,624,400	1,309,974,026	8.68%	11.15%	10.20%	73,604,950	22.20%	451,720,766	34.48%	
Angola	115,562,021	81,794,687	947,119,243	-4.23%	20.73%	10.54%	40,242,817	49.20%	536,805,794	56.68%	
Algeria	69,783,310	36,388,064	838,751,875	-7.82%	27.30%	12.57%	34,832,498	95.73%	787,167,954	93.85%	
Egypt	167,767,463	269,747,428	1,967,533,716	6.12%	16.52%	12.44%	182,600,101	67.69%	1,342,626,438	68.24%	
Morocco	80,195,983	184,475,303	703,985,726	10.97%	10.85%	10.90%	162,821,361	88.26%	630,568,157	89.57%	
Nigeria	125,612,026	249,172,658	862,541,036	8.94%	10.02%	9.61%	181,642,038	72.90%	566,676,563	65.70%	
Africa	548,647,272	1,995,198,981	11,303,337,359	17.51%	14.27%	15.50%					
Selected	466,086,967	1,772,119,626	9,691,870,350	18.17%	13.96%	15.55%					
Selected, share (%)	84.95%	88.82%	85.74%								
South Africa	85,615,655	351,396,860	500,753,093	19.30%	2.76%	8.77%					
Angola	50,607,334	36,800,609	76,386,566	-3.90%	5.78%	1.98%					
Algeria	180,059,771	767,653,833	2,361,294,419	19.87%	9.03%	13.04%					
Egypt	4,431,149	45,804,460	168,816,806	33.91%	10.55%	18.93%					
Morocco	18,905,608	50,181,968	664,919,667	12.98%	21.99%	18.48%					
Nigeria	126,467,450	520,281,896	5,919,699,799	19.34%	20.57%	20.10%					

Table A.2.

Product	Region	1997 Exports (US\$)	1997 Share (% of total)	2010 Exports (US\$)	2010 Share (% of total)	Growth rate (%/yr., 1997-2010)	
						US\$	Share
	Brazilian exports	23,400,603,041		76,441,416,219		9.53%	
	Selected products	15,715,121,122		62,274,433,495		11.17%	
	Share in total Brazilian exports	67.16%		81.47%			1.50%
Cereals	Brazilian exports	91,392,753		2,715,364,724		29.81%	
	Share in Brazilian exports	0.39%		3.55%			18.51%
	Africa (Middle East not included)	9,669,992	10.58%	615,406,150	22.66%	37.64%	6.03%
Coffee	Brazilian exports	3,133,971,896		5,764,620,108		4.80%	
	Share in Brazilian exports	13.39%		7.54%			-4.32%
	Africa (Middle East not included)	29,422,383	0.94%	40,516,572	0.70%	2.49%	-2.20%
Forestry products	Brazilian exports	3,500,949,686		9,281,604,369		7.79%	
	Share in Brazilian exports	14.96%		12.14%			-1.59%
	Africa (Middle East not included)	112,799,792	3.22%	211,824,959	2.28%	4.97%	-2.62%
Meat	Brazilian exports	1,598,437,589		13,629,852,660		17.92%	
	Share in Brazilian exports	6.83%		17.83%			7.66%
	Africa (Middle East not included)	22,015,302	1.38%	1,446,314,217	10.61%	37.98%	17.01%
Soybean-complex	Brazilian exports	5,563,786,330		17,107,048,096		9.02%	
	Share in Brazilian exports	23.78%		22.38%			-0.46%
	Africa (Middle East not included)	67,920,416	1.22%	139,573,353	0.82%	5.70%	-3.05%
Sugarcane-complex	Brazilian exports	1,826,582,868		13,775,943,538		16.82%	
	Share in Brazilian exports	7.81%		18.02%			6.65%
	Africa (Middle East not included)	578,458,628	31.67%	3,179,473,366	23.08%	14.01%	-2.40%

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