SAGCOT

SOUTHERN AGRICULTURAL GROWTH CORRIDOR OF TANZANIA

A Green Growth Investment Framework for SAGCOT

The SAGCOT Greenprint

Draft August 2012

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The development of the SAGCOT Greenprint was led by the Green Growth Technical Team from EcoAgriculture Partners, reporting to the SAGCOT Centre and the SAGCOT Green Reference Group.

The Greenprint author team:

Jeffrey C. Milder

Louise E. Buck

Abigail K. Hart

Sara J. Scherr

Foreword

We suggest that a Foreword by Eng. Mwihava, chair of Green Reference Group, be included here. This Foreword could touch on the following themes:

1. Background on SAGCOT and its importance in meeting Tanzania's national priorities and targets related to food security, poverty alleviation, and economic development
2. Importance of sustainable management of environmental assets to achieve SAGCOT's goals – particularly soils, water, and forests that are all critical for sustainably increasing agricultural productivity
3. Tanzania's serious commitment to and high-level strategies for addressing climate change and its impacts—efforts which must be fully woven into development of the agriculture sector
4. Charge of the Green Reference Group and commitment of the Government of Tanzania to pursuing a Green Growth approach in SAGCOT
5. Mention of some highlights of the SAGCOT Greenprint itself, and the key ways in which this document will guide the roll-out of the SAGCOT program, investments, and activities.

Executive Summary

The SAGCOT Initiative

In 2010, the Government of Tanzania launched the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) initiative as a public-private partnership dedicated to ensuring food security, reducing poverty, and spurring economic development in Tanzania's Southern Corridor. Stretching from the Indian Ocean to the Zambian border, the Southern Corridor encompasses nearly 300,000 square kilometers stretching along both sides of the infrastructure backbone that extends inland from Dar es Salaam. While the region has considerable agricultural potential, it currently suffers from low productivity, low levels of investment, and high rates of poverty. To unlock the region's potential, the SAGCOT initiative seeks to attract more than US $3 billion of investment to dramatically increase food production, increase annual farming revenues by more than US $1.2 billion, benefit small-scale farmers and the rural poor, and establish southern Tanzania as a regional food exporter. It will do so by concentrating and linking agricultural investment from the public sector, development partners, and Tanzanian and international investors to "kick start" the region's latent potential for highly productive agriculture and efficient value chains. To meet these ambitious goals requires a targeted strategy and realistic action plan to deploy resources, engage partners, and coordinate activities and investments throughout the Corridor. In 2011, the SAGCOT Blueprint was released, describing where and how investment in the agriculture sector could be scaled-up and better coordinated to establish productive clusters of new economic activity.

A Framework for Agriculture Green Growth

The Blueprint also identified the important issues of climate change, environmental conservation, and natural resource management as critical to the Corridor's long-term economic development, but did not provide detailed plans to address them. The purpose of this Green Growth Investment Framework (the "SAGCOT Greenprint") is to refine the SAGCOT strategy to ensure that development in the Corridor is environmentally sustainable, socially equitable, and economically feasible. Specifically, the Greenprint lays out a strategy for implementing "Agriculture Green Growth" (AGG) to sustainably intensify agriculture for smallholder and commercial agriculture alike, while simultaneously conserving the natural resource base that supports agriculture and reducing pressure on forests, water resources, and biodiversity.

Why Green Growth for SAGCOT?

Environmental considerations are not peripheral to SAGCOT or its farmers. Productive agriculture in the Southern Corridor is not possible without a suitable climate, sufficient water, and fertile soils. Currently, the region's farmers are highly vulnerable to climate change, with the vast majority relying on rainfed agriculture, with inadequate access to reliable input supplies or markets. Where agriculture has been intensified, it has often had severe environmental impacts, undermining not only long-term productivity, but also the development of other important sectors like forestry, wildlife tourism or water. Rather than repeating mistakes of the past, SAGCOT can follow a new course in which farmers embrace modern technologies and management systems to produce more food with fewer inputs, less waste, and less pollution. This approach recognizes that the most sustainable and least risky farming systems will be those that build in resilient agronomic, environmental, and social management practices. And it recognizes that society now looks to agricultural landscapes to provide a range of goods and services—not just food—and that markets are increasingly rewarding farmers for doing so. In this way, resource conservation, efficiency, and sustainability are not costs of doing business; on the contrary, they are woven into the core logic and business case of all new land-based investment.

Agriculture Green Growth in Action

To mainstream AGG through the Corridor requires action at the level of individual farms and businesses, and at the policy level. At the farm level, sustainable crop and livestock intensification is a core strategy. Systems such as **conservation agriculture** and **system of rice intensification** have been demonstrated to increase grain yields by 100% or more on smallholder farms, while **agroforestry**, **integrated crop-livestock systems**, and other practices are also suitable throughout the Corridor. On large commercial farms and block farms, **precision agriculture** can greatly increase the amount of food produced per unit of water, nutrients, or other inputs—thereby reducing costs, increasing profit, and reducing pollution. **Sustainable livestock intensification** also offers significant opportunities, both for small-scale livestock keepers and for commercial ranches.

A central premise of Green Growth that forests, water, and other critical resources are "investable assets" that can be a focus of private sector as well as public and community investment. Such investment seeks to maintain and increase the productive capacity of the resource, thereby supporting off-take (e.g., forest harvest) that can be sustained indefinitely—as opposed to one-time exploitation. Key investment opportunities include **community forestry enterprises**, **bioenergy**, and **improving water use efficiency**—whether through manual labor and small-scale solutions or through engineered irrigation and water management structures. **Payments for ecosystem services** provide a new vehicle for compensating communities for their investment in natural resources, while maintaining resources of importance to others, such as clean water and carbon stocks. New **differentiated markets and eco-certification** offer direct economic incentives for farmers to use sustainable practices and steward resources.

With its emphasis on mainstreaming sustainable crop and livestock intensification throughout the smallholder sector, the Greenprint strategy will transition large numbers of farmers from subsistence producers to ones that generate marketable surpluses. For this reason, it will be critical to invest in the **post-harvest value chain**, including storage and processing facilities, value addition enterprises, and distribution networks. A wide range of dedicated Tanzanian businesses and cooperatives are already engaged in such efforts, and could be supported to accelerate value chain formation through increased access to finance, training, and technical assistance.

Financing Agriculture Green Growth

The Green Growth approach involves engaging a wide range of investors, going well beyond 'business-as-usual.' They include new sustainable agricultural investment funds, climate mitigation investment funds, international financial institutions with screening criteria for sustainability, and international companies that have incorporated environmental and social values into their business models. An AGG investment pipeline and investment generation facility can link investors with projects in the Corridor that suit their needs, with mechanisms for financing small, medium and cooperative enterprises.

Creating Fertile Ground for AGG

As promising as these AGG practices are, they are unlikely to be implemented at full scale unless they are supported by key policies and investments at the national level. The Greenprint identifies five priority actions to create "fertile ground" for AGG:

1) A systematic program of **agricultural extension for AGG** should be designed and deployed, with the aim of reaching at least 70% of the Corridor's farm households by 2030. This program will draw from proven participatory extension methods already in use in the Corridor and integrated the latest research on context-appropriate AGG practices.

2) The SAGCOT partners should invest in **local organizations and local leadership** (including farmers associations, savings and credit cooperatives, and other groups) as key catalysts capable of disseminating AGG best practices and linking smallholder farmers to markets.

3) A new approach to **planning and allocating land and water** should be designed and adopted to reconcile the objectives of optimizing economic returns from available land and water resources, ensuring equitable land allocation and land rights, and creating a transparent and streamlined process for identifying new sites for investment. This approach can build strongly on existing planning processes in place, but will require some critical new coordination functions.

4) A set of **SAGCOT Investment Guidelines** should be put into place to help steer investors toward AGG practices with broad social and environmental benefits. These Guidelines would enhance, but not duplicate, environmental and social safeguards put in place through other mechanisms.

5) AGG should be mainstreamed into the **SAGCOT Investment Generation Programme** to position the Southern Corridor as a place that attracts "best in class" investors and innovators that integrate sustainability into their business plans.

Next Steps

The next 18-24 months will be a pivotal period to jump-start and build momentum for the AGG approach to development in SAGCOT. The SAGCOT Centre and partners can take specific actions now to generate momentum and lay the foundation for scaling up AGG investments in the region:

- Engage key national and local stakeholders in refining and grounding the AGG vision;
- Strengthen and demonstrate integrated planning in selected Clusters;
- Catalyze investment in selected ready-to-go projects;
- Market the AGG investment program to foreign and domestic investors; and
- Strengthen the analytical and knowledge base for AGG in SAGCOT.

AGG Vision of Success

If the above innovations and supports are implemented as described in the Greenprint, there will be significant benefits for food production, economic output, local livelihoods, and environmental conservation. Compared to a scenario of agricultural intensification based on prevailing practice, the AGG strategy by 2030 will generate an additional 2.2 million tons of rice and field crops per year, worth approximately US $600 million (936 billion TzSh) at recent market prices. These gains will come primarily from smallholder farmers who are unaffiliated with large commercial enterprises. Because such farmers encompass the vast majority of farms and land holdings in the region, efforts to enable them to sustainably intensify production will generate tremendous benefits for aggregate food output, household income and food security.

As a broad segment of the smallholder sector realizes substantial yield gains, pressure for agricultural expansion due to low yields of subsistence production will be alleviated, thus avoiding more than 300,000 hectares of deforestation by 2030. The carbon contained in these forests, combined with emissions reductions associated with AGG, will generate net emissions reductions of about three million tons of CO_2-equivalent per year by 2030, worth about US $30 million at current carbon prices. Over a twenty–year period, an additional 30 million tons of CO_2-equivalent could be mitigated by adopting local biogas-based energy systems. In this way, the Greenprint addresses the key drivers of deforestation in the Southern Corridor, namely agricultural expansion and deforestation to supply wood fuels.

Finally, the Greenprint strategy will save nearly one billion cubic meters of water per year due to increased irrigation water use efficiency, while also increasing water use efficiency for rainfed agriculture. These improvements will enable more water to be available for the expansion of irrigation, for other economic sectors, and for "environmental flows" to support stream habitat and wildlife. As Tanzania becomes a water-scarce country over the next decade, increased water use efficiency is a critical strategy to mitigate water conflict between communities and sectors that could otherwise occur.

The SAGCOT Initiative offers an inspired vision of what could happen if farmers, communities, investors, government, and civil society come together to tackle the challenges of food security, poverty, environmental degradation, and climate change in southern Tanzania. Taken together, the SAGCOT Blueprint and this Greenprint lay out a practical strategy—and an attainable investment program—to realize this vision. If Tanzania commits to making the Southern Corridor a fertile ground for Agriculture Green Growth, millions of people will reap the benefits.

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List of Acronyms

AGG	Agriculture Green Growth
AGRA	Alliance for a Green Revolution in Africa
AIPP	Agricultural intensification with prevailing practices
ASDP	Agriculture Sector Development Programme
ASDS	Agriculture Sector Development Strategy
BAU	Business as usual
CA	Conservation agriculture
CIP	Commodity Investment Plan
CSO	Civil society organization
DADP	District Agriculture Development Plan
FAO	Food and Agriculture Organization of the United Nations
GDP	Gross Domestic Product
GoT	Government of Tanzania
IFAD	International Fund for Agricultural Development
IGP	Investment Generation Programme (of SAGCOT)
KPL	Kilombero Plantations, Ltd.
NAPA	National Adaptation Programme of Action
NGO	Non-governmental organization
OECD	Organisation for Economic Co-operation and Development
PA	Precision agriculture
PASS	Private Agriculture Sector Support
PES	Payment for ecosystem services
REDD	Reduced emissions for deforestation and forest degradation
SACCO	Savings and credit cooperative
SAGCOT	The Southern Agricultural Growth Corridor of Tanzania initiative[1]
SRI	System of Rice Intensification
SRSEA	Strategic Regional Social and Environmental Assessment
TAP	Tanzania Agricultural Partnership
TARIPA	Tanzania Rice Partnership
TzSh	Tanzanian shillings
USAID	United States Agency for International Development
VLUP	Village Land-Use Plan
WUA	Water User Association

[1] The acronym SAGCOT is used in this report to refer to the SAGCOT initiative. The geographic focal area for this initiative is referred to as the "Southern Corridor."

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1. Introduction

Southern Tanzania is a region of rich resources and great potential. It contains some of the country's most fertile lands, extensive forests and wildlife, and access to water, and is served by a backbone infrastructure of paved highways, rail, and electric transmission lines. Yet, the region suffers from low productivity, high poverty, worsening environmental degradation, and a host of unfulfilled promises. Recent trends suggest that without bold action, these problems will likely only get worse.

However, a different future is possible, one that develops southern Tanzania into a major regional food producer and engine of national economic development, dramatically reduces poverty among its nine million residents, and sustains the region's ecosystems as the productive base of future wellbeing. This document describes that future—and how to achieve it.

With the multitude of challenges and opportunities facing southern Tanzania, a "silver bullet" approach to economic growth is neither possible nor desirable. Instead, the region needs an integrated strategy that aligns investment in land and natural resources to support agriculture, livestock, and forestry, as well as tourism, industrial development, and other sectors.

At the heart of this strategy must be agriculture. Agriculture is the mainstay of Tanzania's economy and culture, providing primary income for up to 85% of Tanzanians. Recognizing this importance, the Government of Tanzania (GoT) has launched important new initiatives to support increased agricultural productivity. In 2006, the GoT unveiled its Agriculture Sector Development Strategy (ASDS) and corresponding Agriculture Sector Development Programme (ASDP) to increase government support for green revolution in Tanzania. This Programme is targeted to meet local needs—identified through participatory priority-setting exercises at the district level—and backed by major new financial commitments. In 2009, the GoT launched a complementary strategy entitled *Kilimo Kwanza* (Agriculture First) to engage the private sector strongly in agricultural development.

Meanwhile, at the international level, leading private companies were converging around the idea that responsible new private investment in agriculture in the developing world—directly engaging small-scale farmers—could be a key to accelerating poverty reduction and food security where these were most needed.[2] And, based on patterns of agricultural land management and potential for yield gains, global food and development experts were emphasizing the importance of supporting smallholders as key agents in a future renaissance of African agriculture.

Nowhere in Tanzania is the potential for sustainable intensification of agriculture greater than in the Southern Corridor, a vast region of nearly 300,000 square kilometers (about one-third of the nation's territory) stretching from the Indian Ocean to the Zambian border, along both sides of the infrastructure backbone of roads, rail, and electrical power that extends inland from Dar es Salaam (see Figure 1-1). The region boasts many areas of good soils, adequate rainfall or potential for irrigation, and access to domestic, regional, and international markets.

The SAGCOT Initiative: Concept, Strategy, and Ambitions

In 2010, these threads were woven into whole cloth with the launch of the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) initiative by President Jakaya Mrisho Kikwete at the World Economic

[2] This idea, and a roadmap for implementing it, were presented, among other places, in a report entitled "A New Vision for Agriculture," first published by the World Economic Forum in 2010.

Forum (WEF) in Davos, Switzerland. Since its launch, SAGCOT[3] has generated widespread interest and hope as a model for African agricultural development that can dramatically increase food supplies, reduce poverty, and stimulate economic development. The initiative has been featured prominently at major international forums including the UN Climate Change Convention Conference of the Parties, G8 Summit on Agriculture, and regional WEF events.

The SAGCOT vision is spelled out in the SAGCOT Blueprint, a strategy for scaling up productive, profitable commercial agriculture in the Southern Corridor over the next twenty years. This strategy is centered on three key features:

1) **Public-private partnership:** Several barriers currently inhibit the competitiveness of Tanzania's agriculture sector, from spotty input supply chains to poor roads to business-unfriendly policies. To overcome these substantial barriers to investment, the Blueprint calls for coordinated, co-located investments by multiple public and private actors. These investments will include farm development and improvement, post-harvest processing, storage and distribution facilities, infrastructure, research and extension, as well as policy reform.
2) **Cluster concept:** Core to the SAGCOT strategy is the 'cluster' approach, which posits that greater progress can be made by co-locating different types of investments in specified priority areas. Such clustering creates essential vertical integration of agricultural production, processing, and marketing, while ensuring a critical mass of demand and supply to sustain full-service agricultural input supply chains, post-harvest value chains, and support functions. The Blueprint identified six clusters as especially ripe for investment (see Figure 1-1), although the SAGCOT initiative is not limited to these clusters, and additional geographic focal areas have since been proposed.
3) **Attention to impact on smallholders:** Agriculture in the Southern Corridor is dominated by small-scale farmers. This is the population segment that also suffers most acutely from poverty and food insecurity. The SAGCOT strategy seeks to benefit smallholders by helping them increase farm productivity and engage in commercial value chains. This would be achieved through participation in outgrower and block farming schemes oriented around nucleus large-scale farms, and through greater access to inputs, extension, and more favorable post-harvest marketing opportunities.

> *"SAGCOT aims to facilitate the development of clusters of profitable agricultural businesses [that] result in strong synergies across the agricultural value chain, helping create the conditions for a competitive and low-cost industry."*
>
> --SAGCOT Blueprint

Together, these approaches are meant to "kick-start" private sector activity to overcome the initial high costs and risks of agricultural development in the Southern Corridor. The Blueprint envisions a development program that, by the year 2030:

- Brings an additional 350,000 hectares of land into commercial agricultural production, serving regional and local markets;
- Attracts US $3.4 billion (5.1 trillion TzSh) of new investment, more than 80% of which would be private investment;
- Increases regional production by 630,000 tons of rice, 680,000 tons of other grains, 4.4 million tons of sugar cane, 3,500 tons of red meat, and 32,000 tons of fruits and vegetables;

[3] Note: The acronym SAGCOT is used in this report to refer to the SAGCOT Initiative. The geographic area defined as the Southern Agricultural Growth Corridor of Tanzania is referred to as the "Southern Corridor."

Figure 1-1 (SAGCOT corridor basemap) is available separately for download.

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- Provides new annual farming revenues of US $1.2 billion (1.8 trillion TzSh);
- Engages tens of thousands of smallholder in irrigated commercial agriculture;
- Provides more than 420,000 new jobs in the agricultural value chain, and lifts more than two million people out of poverty; and
- Ensures regional food security for a growing population through gains in agricultural productivity, processing, and distribution.

To collaborate in unplugging the bottlenecks to productive agriculture in the Southern Corridor, SAGCOT partners recognize the need to foster a new climate of partnership and trust. To this end, the SAGCOT Centre was established in 2011 to play a coordination and facilitation role for the initiative. Under the slogan of "business unusual," the Centre is building a platform for public-private collaboration that brings together key public and private actors, from farmers and local businesses to international investors and high-level government officials.

Agricultural Development, Environment, and Climate Change

Productive agriculture in the Southern Corridor is not possible without a suitable climate, sufficient water, and fertile soils. More than in many places, farmers in the Southern Corridor depend heavily on a healthy environment: over 95% of the region's farmers practice rainfed agriculture, and most use little or no chemical fertilizer, pesticide, or herbicide. Fortunately, many parts of the Southern Corridor are richly endowed with potentially productive agricultural soils; areas of good rainfall, surface and groundwater resources; and healthy forests and grasslands. But these resources are unevenly distributed, finite, and already significantly exploited. For instance, even at currently modest productivity levels, water in the upper reaches of the Great Ruaha River basin is fully exploited by rice farmers, leaving insufficient water for wildlife and hydroelectricity generation. In many places, unsustainable management has led to degradation that reduces the land's productive capacity to produce food and support farmer livelihoods.

> *"The greatest challenge for agriculture is to feed a bigger and richer global population, on increasingly degraded land, with less water, and in the face of more extreme weather events, while also being asked to provide more environmental services, more bioenergy and more raw materials for industry."*
> *--Shenggen Fan, International Food Policy Research Institute*[4]

In short, to meet the goals of the SAGCOT Blueprint to achieve productive agriculture on a sustained basis, the region's land, soil, and water resources must be used more efficiently to enable economic growth despite limited resources. And activities must be carefully planned to maintain the renewable natural resources that support agriculture. This approach is a departure from "Green Revolution" development strategies of the past, which focused mainly on external inputs and tended to view the environment as irrelevant or even antagonistic to agricultural development. But experience from other countries has shown that approaches to agricultural development focused narrowly on short-term crop yields are liable to create lasting and expensive problems, often without equitably addressing poverty and food security challenges (see Box 1). For this reason, there is a growing consensus that the Green Revolution of this century should take a different approach.

21st century agricultural development strategies must respond to new realities, while learning from the successes, disappointments, and unintended consequences of last century's narrowly defined prescriptions for agricultural intensification. For instance, such strategies should embrace new technologies and

[4] Quoted in the New Agriculturalist, July 2012, http://www.new-ag.info/en/pov/views.php?a=2725.

management systems enable farmers to produce more food with fewer inputs, less waste, and less pollution. They must recognize that climate change will dramatically change agricultural suitability in ways that are not fully predictable, and that the most sustainable and least risky farming systems will be those that build in resilient agronomic, environmental, and social management practices. They should consider that sustainability requires action both on the part of individual farmers and on the part of governments, private companies, and civil society working together at larger scales to maintain healthy watersheds and landscapes. And such strategies must recognize that society now looks to agricultural landscapes to provide a range of goods and services—not just food, but also clean water, habitat for wildlife, energy, forest products, healthy environments for people, stable climate—and that markets are increasingly rewarding farmers for doing so. Development strategies that do not reflect these new realities, are not only antiquated; they are unwise.

Box 1-1. Learning from 20/20 Hindsight: Lessons from Agricultural Development in Brazil and Asia

As Tanzania crafts its strategy and investments in SAGCOT, it can benefit from lessons learned from agricultural development elsewhere around the world over the past 50 years. Many different development models have successfully increased agricultural production, but with widely divergent impacts on poverty reduction and the environment. Here, we present examples from Brazil and the "Asian Tigers" of South Korea and Taiwan to illustrate some divergent experiences and highlight important lessons for Tanzania.

Brazil's rapid agricultural growth based on large-scale crop and livestock enterprises in the Cerrado is widely known. This model was premised on large areas of land with very low population densities (less than three people per square kilometer, compared to ten times that in the Southern Corridor) and has caused large-scale deforestation and hydrological disruption. Finding ways to shift land use dynamics and restore ecosystem services is proving difficult and expensive. Less well known are the many successful Brazilian models of small- and medium-size commercial agricultural enterprises in more populated areas. For instance, Brazil has developed impressive production and land management technologies for commercial agroforestry, micro-dosing of agrochemicals, organic production, and minimum tillage for smallholder development that have much lower environmental footprint as well as much more widespread benefits for poverty alleviation.

South Korea and Taiwan experienced rapid agricultural growth in the past 50 years, accelerating most rapidly during the heyday of the Green Revolution in the 1970s. Government-led investment supported improved and expanded irrigation, increased chemical inputs, and improved seeds. Like Tanzania, the agricultural sector in these countries was dominated by smallholder farmers, so the governments pursued a smallholder-focused growth strategy. This growth is credited with kick-starting a wider process of economic development in both countries through investment of economic surpluses from agriculture in other sectors, development of agro-processing and agriculture-related businesses, and high economic multipliers associated with smallholder development. The model had high environmental costs, however, as irrigation investments were implemented without regard for hydrological systems and over-use of agrochemicals polluted drinking water and commercial fisheries, harmed human health. and greatly diminished biodiversity. Soil degradation (salinity, waterlogging, chemical toxicity, hardpan, loss of soil nitrogen) and rising costs of energy and fertilizer have greatly slowed (and in some cases even reversed) yield growth. In the 1990s, both countries began major investments to help farmers shift to more ecologically sustainable agricultural systems and investment in large-scale restoration of degraded resources.

Southern Tanzanian farmer, business and government leaders can usefully review these experiences and draw from them the elements that are likely to have the greatest benefits for food supply, poverty alleviation, economic development, and ecosystem health in both short- and long-term. Recent major international assessments and recommendations on future pathways for agricultural development identify a myriad of ways to pursue smallholder-focused strategies contributing to agricultural green growth, drawing on the latest science and innovation from the field. These contemporary approaches appear capable of providing the widespread yield gains of earlier Green Revolution approaches, with far-reaching livelihood benefits, but with greatly reduced negative impacts on the environment and human health, and with greater foresight to a future of high energy prices, water limitations, and climate change to which farmers will need to adapt.

Developing an Agriculture Green Growth Investment Framework

With these realities in mind, in 2011 a core set of SAGCOT Centre partners embarked on the process of "greening" the SAGCOT strategy to ensure that:

1) Farmers, investors, and other stakeholders are aware of and can fully capitalize on new opportunities to apply sustainable production, processing, and supply chain practices to reduce costs and risks, increase profit, and increase the flow of benefits to local communities;
2) The gains in agricultural productivity and profitability realized by public and private investment in SAGCOT can be sustained indefinitely, even in the face of future climate change and resource scarcity;
3) Agriculture in the Southern Corridor is developed in harmony with the natural environment, and maintains the benefits that ecosystems provide to farmers, communities, and the nation as a whole;
4) The SAGCOT strategy fully considers and addresses climate and environmental risks, both to the livelihoods of rural people and communities and to the bottom lines of private and public investors; and
5) The Southern Corridor is developed according to a forward-looking vision of sustainable development that is worthy of emulation elsewhere in Africa.

The Green Growth Investment Framework addresses these goals by defining a coherent strategy for attracting and coordinating investment in agricultural production, processing, and distribution that is efficient, profitable, sustainable, and resilient to climate change. We call this approach Agriculture Green Growth (AGG). While AGG incorporates traditional environmental management tools such as environmental impact assessments and regulations, its focus is on identifying and catalyzing new opportunities and investments for sustainable economic growth. Thus, this Investment Framework can be considered as a "Greenprint" for SAGCOT that complements the Blueprint by creating a roadmap for using sustainable approaches to more effectively meet the goals of the Blueprint.

The Greenprint was developed from October 2011 through August 2012 by the SAGCOT Green Reference Group, SAGCOT Centre, and other stakeholders, with facilitation and technical support from EcoAgriculture Partners. The process was designed to embody SAGCOT's motto of "business unusual" by bringing together key stakeholders from all levels (from smallholder farmers and village leaders to high-level government officials and international investors) and all relevant sectors in an environment of maximum transparency. Throughout the process, a web-based Agriculture Green Growth Portal and listserv were used to share project documents and Green Growth ideas and opportunities to build interest in the Green Growth concept and invite input into the Greenprint development process.

The process included four main activities. First, the Green Growth team conducted an assessment of agriculture, environment, and climate conditions, trends, and challenges for the Southern Corridor to inform key needs and opportunities for the Greenprint. Second, the team conducted a consultation process with key SAGCOT stakeholders and experts to understand existing Green Growth activities, opportunities, and barriers in the corridor. This process included field work in three of the SAGCOT focal clusters, more than 150 in-person and telephone/Skype interviews, and "electronic consultation" via the Agriculture Green Growth Portal and listserv. Third, the team facilitated a three-day Green Growth Leaders Workshop in Dar Es Salaam in May 2012 to enable cross-sectoral discussions on the emerging Greenprint. This workshop resulted in a wide range of innovative ideas and some emerging consensus

about AGG development priorities in each cluster.[5] Finally, the Greenprint itself was developed in draft form, reviewed publicly by SAGCOT stakeholders, and finalized. Ongoing efforts of the SAGCOT Centre, GoT, and other partners are now critical to ensure that the ideas in the Greenprint are mainstreamed into investment and policy decisions throughout the Corridor.

Overview of the SAGCOT Greenprint

The SAGCOT Greenprint defines a vision and strategy for scaling up Agriculture Green Growth in the Southern Corridor, with benefits for farmers, communities, investors, and the United Republic of Tanzania. Following this Introduction, Chapter 2 explains the need for a Green Growth strategy by highlighting key conditions and trends in the Southern Corridor that will affect the implementation of the SACGOT Initiative. Chapter 3 introduces the Agriculture Green Growth concept and investment framework, and clarifies the ways in which the Greenprint aligns with and builds on the SAGCOT Blueprint.

At the heart of the Greenprint, Chapters 4 through 6 lay out an operational strategy for implementing AGG for SAGCOT. Chapter 4 identifies a set of 'best-bet' AGG opportunities and defines the actions and investments needed to mainstream these in the Southern Corridor. Chapter 5 highlights the key supporting activities, institutions, and policies needed to facilitate the broad uptake of AGG. Chapter 6 illustrates how sets of AGG practices, support activities, and policies can come together to create productive, prosperous, sustainable landscapes—using as an example three of the SAGCOT priority clusters.

The final chapters define a roadmap for achieving the Greenprint vision and objectives, including a strategy for financing and investment generation (Chapter 7) and next steps for the SAGCOT Centre and its partners (Chapter 9). Chapter 9 presents a vision of what a successful Agriculture Green Growth development program would achieve by the year 2030.

In the interest of keeping the Greenprint itself concise, detailed supporting materials are provided as Annexes. These Annexes provide additional information on existing conditions related to agriculture, environment, and climate in the Southern Corridor; calculations related to the Greenprint development program; a glossary; bibliography; and other materials. The set of eight AGG Opportunity Analyses in Annex B may also be used as stand-alone documents by SAGCOT partners for training and outreach related to AGG in the Southern Corridor.

[5] For a summary of the workshop and key outcomes, please see the workshop report, available from the SAGCOT Centre or at www.AgricultureGreenGrowth.com.

2. Why Green Growth for SAGCOT?

Around the world, governments, civil society, and the private sector are working together to develop and implement "Green Economy" and Green Growth strategies to generate equitable, sustainable economic development. These strategies stem from a mutual understanding that finite resources and a new climate of opportunities and risks necessitate new, green development strategies. The precise rationale and need for Green Growth differs from place to place, depending on a country's development ambitions, environment, and other conditions.

In the Southern Corridor, nearly the entire economic base—from agriculture and livestock to tourism, mining, and forestry—depends on sustaining ample clean water, fertile soils, healthy ecosystems, and wildlife. With this in mind, this chapter highlights key conditions and trends in the Corridor that necessitate a Green Growth approach to meet the objectives of SAGCOT. Fortunately, such an approach is already being pursued in Tanzania, at least in official policy. The chapter reviews some of the existing commitments to Green Growth in Tanzania, and illustrates how the Southern Corridor can serve as a flagship region for carrying through on these commitments.

"...the only forward-looking agricultural development strategy for the Southern Corridor is a Green Growth strategy that recognizes and responds to the region's key limitations, opportunities, and trends."

Nine Reasons for Greening SACGOT

In recent years, much good work has been done to review conditions and trends related to agriculture, environment, and climate in the Southern Corridor (please see Annex C for additional information). Rather than providing an exhaustive review, this section highlights nine key factors that will be especially important in shaping and constraining development opportunities in the Southern Corridor in the coming years. The Greenprint strategy focuses on addressing these issues to ensure that gains in food security and economic output will be sustainable indefinitely.

1. **Resource-conserving agriculture is the best—and in some places the only—way to harness the Southern Corridor's agricultural potential.** Portions of the Southern Corridor are blessed with adequate rainfall, surface water, and suitable agricultural soils. But very little of the region is free from at least one major agricultural constraint. For instance, many of the soils in the Corridor are heavily subject to erosion, require enhancement of soil organic matter to attain viable yields, or requires application and management of specific macronutrients. Farmers may attain short-term yields through slash-and-burn agriculture or nutrient mining (i.e., farming nutrient constrained soils without managing or replacing nutrients lost through harvest or erosion), but in the long run, this approach will only exacerbate poverty, land degradation, and deforestation.

   To sustain ongoing productive agriculture, most lands will require careful stewardship of soils and water resources. Practices such as soil surface conservation, mulching, no-till agriculture, integrated grazing management, and precision application of water and nutrients are cost-effective and fully applicable to small-scale, low-input farms as well as to large-scale mechanized agriculture. Unfortunately, only 0.3% of funds allocated by the Ministry of Agriculture, Food Security and Cooperatives to support the DADPs goes to support soil and water conservation. New commitments are needed to achieve sustainable intensification of agriculture.

2. **The well-being of smallholders depends on resilient, resource-conserving farming systems and diversified livelihoods.** In general, smallholder agriculture depends heavily on local natural resources

to support productivity, whereas large-scale farms tend to make greater use of chemicals input, fossil fuel energy, and machinery. By the same token, smallholders tend to be more susceptible to climate change, drought, and other shocks than are large-scale farmers, who may have greater access to irrigation, capital, labor, and input and output markets that can serve as buffers against disaster.

The SAGCOT Blueprint proposes to increase access of smallholder farmers to irrigation, inputs, and markets that can help buffer against certain risks. However, these changes will initially reach only a minority of smallholder farmers. For instance, less than 3% of farmland in the Southern Corridor is irrigated, and even by 2030 this figure will remain below 10%, with irrigation focused on commercial farms. Similarly, fewer than 3% of smallholders are expected to gain access to input supplies, farm services, and output markets through their participation in outgrower schemes or block farms linked to commercial farming hubs. An important complementary strategy for mitigating risk and improving livelihoods is to work with farmers associations and rural communities to diversify farming systems with multiple crops and varieties and to use resource-conserving agricultural practices. This approach can also benefit smallholder farmers engaged in outgrower schemes and block farming by reducing their dependence on a single crop, increasing income flows, and improving household nutritional status.

3. **Limited water resources in the Corridor can yield the greatest economic benefit if they are strategically planned, allocated, and managed.** While portions of the Southern Corridor now have adequate rainfall or surface water to support productive agriculture, as demand grows, scarcity and conflict will inevitably grow. In fact, even at current production levels, conflicts have arisen related to water use among key sectors including crop agriculture, livestock, hydroelectric power, wildlife/tourism, and urban use. For instance, irrigation water use in the upper reaches of the Great Ruaha basin has resulted in the extinguishment of dry season flows downstream, in the Great Ruaha National Park, where the tourism industry depends on such flows to attract large game to seasonal water supplies. Upstream agricultural water use has also reduced reservoir levels at the Mtera Dam, contributing to blackouts that cost Tanzania nearly one trillion TzSh per year.[6] Hydropower shortages—primarily in the Southern Corridor—will worsen under projected climate change scenarios, costing the country a loss of 0.7-1.7% of its GDP by 2030.[7] The situation could be improved by increasing irrigation water use efficiency in the Usangu Flats, which currently stands at just 24% for dry-season crops.

   Without a more comprehensive, efficiency-oriented approach to water resource management, it is very unlikely that the Southern Corridor could support the levels of irrigation and food production proposed in the Blueprint, let alone set aside enough water to support critical economic growth in other sectors. A central tenet of Green Growth is to optimize the economic and social benefit gained from a limited renewable resource such as water. Doing so will require a SAGCOT strategy that: 1) efficiently allocates water use among key sectors; 2) increases water use efficiency in each sector, but particularly in agriculture, where the greatest gains may be realized; and 3) increases water availability through effective watershed management.

4. **Effective land use planning is needed to reduce conflict, attract beneficial investment, and maintain a productive resource base for agriculture and other activities.** Land use and land rights in Tanzania are governed by a complex and sometimes contradictory mosaic of policies, institutions, and planning processes. Too often, this situation results in a lose-lose scenario that provides too little certainty for investors, too little protection for communities, and too little coordination among different sectors and investors that are each making their own plans. Land conflicts between

[6] World Bank 2006, cited in Economics of Climate Change in Tanzania, Water Resources report.
[7] Economics of Climate Change in Tanzania, Water Resources report.

agricultural communities, pastoralists, and commercial farms continue to escalate, and serve as a disincentive to outside investment. The nation's process for participatory Village Land Use Planning has yielded positive results in many places where it has been applied, but plans have been developed for less than 10% of Tanzania's villages.

As with water resources, a Green Growth approach to land resources seeks to optimize total benefit through cross-sectoral planning that locates land uses in the most suitable location. This approach helps reduce conflict between uses such as agriculture, grazing, wildlife management, industrial development, and mining. Pro-active planning is key to establishing a "land bank" of sites where agricultural investment is physically suitable and welcomed by local communities. In this way, planning can increase opportunities and reduce pre-development costs for investors.

5. **Energy supply presents a major challenge and opportunity for the future of the Southern Corridor.** Fuelwood and charcoal provide 92% of Tanzania's total energy, while fuelwood is the primary fuel for tea drying, tobacco curing, and other key agro-processing in the Southern Corridor. This high reliance on bioenergy is predicted to remain very high for the foreseeable future.[8] As a major economic activity and land use in the Southern Corridor, bioenergy harvesting and use is a key factor that must be addressed if the region is to achieve a sustainable growth trajectory. At present, the bioenergy sector is a primary driver of Tanzania's high deforestation rate, and competes with agriculture for limited land, water, and biomass resources.

   However, with the right incentives, training, and support, farmers, rural communities, and businesses in the Southern Corridor can produce bioenergy sustainably to provide energy for local use and domestic markets. Biogas, woodlots, agroforestry, crop residue management, and others practices and technologies can help support agriculture, livelihoods, and forest conservation. A Green Growth approach pursues such synergies between the energy, agriculture, and forestry sector, with the added benefit of reducing net carbon emissions associated with economic development and population growth. Increased household energy use efficiency (e.g., improved cookstoves) is an additional solution that generally results in cost savings while reducing energy demand and carbon emissions.[9]

6. **With climate change, agriculture suitability is shifting in important ways.** The precise impacts of climate change in the Southern Corridor in the coming decades are difficult to predict. Models suggest that by 2050, temperatures will rise by 1-3°C, maize yields could decline 20-40%, while some mid-altitude crops (such as coffee) could see productivity gains. What is already apparent to many of the region's farmers is that climate change is resulting in more seasonal and annual variability in rainfall patterns, higher temperatures, less overall climate predictability, and a corresponding increase in risk. A recent nationwide assessment predicted that climate change could dampen Tanzania's GDP growth by 1-2% per year by 2030. To counter this risk, investments of at least US $600 million per year are needed to build adaptive capacity against current and future climate risks.

   Some farmers are beginning to adapt to climate change by shifting to different crops; others are experimenting with different varieties and planting schedules. But adaptation for agriculture requires a comprehensive approach that includes actions at the farm, community, and regional level. Such actions should engage not only the agriculture sector but also policies and programs related to forests, water, infrastructure, and community development. Green Growth explicitly considers climate change

[8] FAO sustainable woodfuels report; Tanzania National Energy Policy (2003)
[9] Among the climate mitigation options with negative net cost, efficient use of biomass and charcoal in domestic cooking is capable of providing the largest emissions reductions, totaling an estimated 13 million tons of CO_2-equivalent per year by 2030. Source: "Opportunities for Low Carbon Investment in Tanzania" (2010).

in development and investment planning, seeking to minimize future risks to economic prosperity and especially to poor and vulnerable populations.

7. **Agricultural development should not undermine development in other sectors, or vice versa.** Tanzania's Development Vision 2025 and the corresponding National Strategy for Growth and Reduction of Poverty (MKUKUTA) present a comprehensive development vision that aims to achieve middle-income status for Tanzania by 2025 by pursuing aggressive growth in all major sectors. Doing so requires that each sector have access to the critical means of production (raw materials), infrastructure, and capital needed for its growth. As noted above, agricultural expansion—if not carefully planned, located, and managed—may negatively compete for land, water, and other resources needed to support growth in tourism, mining, urban and industrial development, and other sectors. If gains in agriculture are offset by reduced growth in other sectors, it will be difficult to fulfill the promise of MKUKUTA.

   On the other hand, a Green Growth approach to agricultural development could actually support synergistic growth in other sectors. Water-efficient agriculture would leave aside enough water for hydropower, industry, households and local processing, and environmental uses, while best management practices in agriculture would ensure that downstream waters are clean for human and livestock use. Wildlife-friendly design of agricultural regions would enable large game to migrate across the landscape, sustaining abundant wildlife populations to support tourism growth. And sustainable intensification of agriculture on existing lands could enable more forests to be reserved for sustainable forestry, tourism, or sale of carbon credits.

8. **Farmers and investors in the Southern Corridor stand to benefit from new business opportunities related to sustainable production, processing, and marketing—but only if they choose to deliberately pursue these opportunities.** Increasingly, markets for agricultural goods are differentiating raw commodities and consumer products based on the way in which these goods were produced. Voluntary agricultural eco-standards have grown exponentially in the past decade, while similar sets of criteria are now being mainstreamed into sourcing policies for major agribusiness companies and even into public policy. The trend toward sustainability standards began with high-value export crops such as coffee and tea, but is rapidly expanding to include commodities such as sugar, soy, cattle, and various biofuel feedstocks. While sustainability standards remain most important for export to developed countries, developing country domestic markets and south-south trade are now expanding. In addition to opening up new market opportunities to attain higher prices and preferred market access, adherence to sustainability criteria and agricultural best management practices is often worthwhile in its own right, by assisting producers in reducing waste and increasing efficiency and productivity.

9. **Tanzania is one of the world's great centers of biological diversity—a heritage with enormous value for the economy, culture, and national identity.** Tanzania is one of the most biodiverse countries in all of Africa, home to many of Africa's iconic game species and its most famed safari circuits. Within the Southern Corridor, the Eastern Arc Mountains are among the most biodiverse places on earth, home to three species of monkey and more than 450 species of plants found nowhere else in the world. Species new to science are still frequently discovered in these mountains. Unfortunately, rampant deforestation is destroying more than 400,000 hectares of native habitat annually across Tanzania, while wildlife populations are further threatened by habitat fragmentation, hunting, grazing, and other activities. Sadly, much of this deforestation contributes little to the national economy, serving mainly to support subsistence livelihoods for people who have few other alternatives. With its abundance of protected areas, biodiversity hotspots, and wildlife corridors in close proximity to high-potential agricultural land (including in the priority clusters), the Southern

Figure 2-1 (SAGCOT corridor protected areas) is available separately for download.

Figure 2-1 (SAGCOT corridor protected areas) is available separately for download.

Corridor exemplifies the challenge of achieving agriculture-led economic development while conserving nature (see Figure 2-1).

Fortunately, conservation of Tanzania's biodiversity is fully compatible with a strategy for robust economic growth and poverty reduction. Through Green Growth, agriculture and livestock production can be sustainably intensified to a degree that virtually eliminates the need for further expansion into high conservation value habitats. Sustainable energy alternatives can increase energy efficiency and dramatically reduce fuelwood and charcoal demand. In these ways, the nation's biodiversity can be preserved as an asset to support tourism, recreation, and an enduring source of national pride.

In short, the only forward-looking agricultural development strategy for the Southern Corridor is a Green Growth strategy that recognizes and responds to the region's key limitations, opportunities, and trends.

Consistency with National and Community Priorities

In many ways, Tanzania has already embraced a Green Growth approach to development in key policies and initiatives, although not all of these have been fully implemented (Box 2). At the highest level, the National Strategy for Growth and Reduction of Poverty (MKUKUTA) advocates a strong focus on sustainable natural resource management and inter-sectoral coordination to achieve broad-based, lasting growth. Current climate change planning activities encompass key Green Growth principles of increasing the adaptation and resilience of farmers and communities while reducing greenhouse gas emissions. And there are some efforts and institutions to facilitate integrated land and natural resource planning for sustainable development, although the various programs of this sort are not fully implemented or aligned.

Tanzania also has a strong tradition and legal framework for empowering grassroots sustainable development initiatives, centered on agriculture and natural resource management. The agriculture and livestock sectors have embraced a participatory approach to priority setting and have launched important initiatives related to sustainable intensification of agriculture. In the forestry sector, there is a strong tradition of community-based management that seeks to empower and incentive local management of forest resources for conservation and income generation. And, stemming from Tanzania's tradition of cooperatives, there is a dense network of farmers groups, credit cooperatives, and other local associations equipped to support agricultural growth that directly benefits the poorest households.

Box 2-1. Building on a Solid Foundation: Some Existing Initiatives and Policies that Support Green Growth in Tanzania

National Strategy for Growth and Reduction of Poverty (MKUKUTA)

- MKUKUTA emphasizes agriculture as a key sector for economic development and poverty alleviation. The strategy prioritizes several Agriculture Green Growth interventions, including improved water management and rainwater harvesting, research and development to improve crop quality, and crop insurance and other protections against drought and famine. Farmers groups, cooperatives, and women are highlighted as central actors in agricultural development, to be supported by new training, support, and access to credit. MKUKUTA also calls for improved natural resource management to reverse land degradation, reduce biodiversity loss, and increase contributions from wildlife, forestry, and fisheries to rural livelihoods.

Agriculture:

- Kilimo Kwanza (Agriculture First), developed under the Comprehensive Africa Agriculture Development Plan (CAADP), is the Tanzanian government's policy to spark a green revolution in Africa by establishing agriculture as a top-priority by boosting government spending and targeting smallholders. The policy calls for a rearrangement of government institutions and funding mechanisms that will facilitate public-private partnerships, support agricultural research, and shift public thinking to recognize agricultural development

as a key component of poverty reduction and food security.

- Agriculture Sector Development Programme (ASDP) is a basket fund established by several international partners along with the Tanzanian government to boost the development of the agricultural sector. Funds are distributed based on District Agricultural Development Plans (DADPs), which help to guarantee local participation and invite investments that are tailored to local conditions.

- Tanzania Agriculture Partnership (TAP), a public-private partnership, was developed in 2006 to coordinate district-level activities to improve the production and marketing of stakeholder-selected crops. The original focus of the partnership was on improving access to inputs, although the partnership has now expanded to include marketing and financial tools to support investments. A value-chain approach draws in diverse partners to work at district and national levels to meet agriculture and development goals simultaneously.

- The Agriculture Policy of 1997 emphasizes the importance of integrated natural resource management of land, soil, water, and vegetation to maintain a healthy and productive environment.

Forestry:

- Participatory forest management (PFM) is sanctioned under Tanzanian law and practiced on more than 3.6 million hectares nationwide. PFM includes both communal management of village forests and community co-management of government forest lands. Both approaches can help reduce deforestation and support Green Growth by giving communities financial incentives and secure rights to sustainably manage forests and surrounding land uses. If REDD+ financing materializes, it could help support PFM at a wider scale.

Climate change:

- Tanzania's National Adaptation Programme of Action (NAPA) is a broad, cross-sectoral strategy to enable the nation to prepare for and adapt to climate change. At least seven of the strategy's 14 priority project activities are Green Growth practices for agriculture and rural land management. These include increased water efficiency and water conservation in crop production; afforestation of degraded lands; water harvesting; and improved land tenure systems.

- Reducing Emission from Deforestation and Forest Degradation (REDD) aimed to slow agricultural expansion into forests and the conversion of pasturelands by paying communities for avoided carbon emissions resulting from forest conservation. Now REDD+ provides financial incentives to communities not only for halting deforestation and degradation, but also for engaging in forest conservation, sustainable forest management and the enhancement of forest carbon stocks.

Integrated land and water planning:

- The Land Act and Village Land Act, written in 1999, grant the right to villages to manage customary village lands which compose about 70% of all lands in Tanzania. Under this act villages maintain the right to zone land for forest reserves, investment or agriculture. The National Land Use Planning Commission (NLUPC), created from the National Land Use Planning Act (2007), is responsible for developing and administering land use plans for general lands and reserved lands, which include all gazetted protected areas and land for public utilities. The NLUPC also manages any regional, district or village lands that are not actively managed by their respective governing bodies.

- The River Basin Water Offices cut across administrative boundaries to oversee development and management of water resources in the nine major water basins. Each office is responsible for monitoring available resources, regulating use and issuing permits, collecting fees, and mediating water-related conflicts. The size and location of the basin often dictates if sub-basin Water User Associations (WUAs) and Apex Water Bodies (AWB) or International Basin Authorities take on some of the responsibilities of regulating use and mediating conflicts.

- Since 1975, the Rufiji Basin Development Authority (RUBADA) has existed to coordinate the multi-sectoral development of water resources in the Rufiji Basin. No other river basin in the country has two separate institutions for managing water resources, therefore RUBADA has a unique relationship with Rufiji Basin Water Office (RBWO) with RUBADA focusing on private sector involvement and coordination and the RBWO managing permits, fees, allocation and conflict resolution.

Participatory development:

- Participatory planning and decision-making is a core principle of Tanzania's Development Vision 2025 and of MKUKUTA and has been codified in key sector policies including the Forest Policy of 1998, Wildlife Policy of 1998,Land Policy of 1995. The agriculture, forestry, and land use planning processes described above are some of the more important ways in which participatory development is carried out in Tanzania.

3. A Framework for Agriculture Green Growth

Before presenting the SAGCOT Greenprint strategy, it is helpful to define Agriculture Green Growth in greater detail. AGG for the Southern Corridor builds from contemporary sustainable development approaches, but adapts them to the specific context of an agricultural growth corridor in Africa. This chapter lays out a simple framework for AGG that answers the following questions:

- What is AGG and how does it relate to other key concepts?
- How does AGG differ from business-as-usual?
- What types of investors and investments are needed to support AGG?
- Who benefits from AGG?
- How does AGG add value to the strategy presented in the SAGCOT Blueprint?

The Agriculture Green Growth Concept

Agriculture Green Growth includes agricultural production, processing, distribution, and marketing activities are productive and profitable while also protecting and restoring the environment. Through improved efficiencies, AGG investments achieve benefits such as greater yields, increased productivity per unit of input, reduced risk, and increased market access. AGG also helps farmers become more resilient to droughts and climate change.

AGG seeks to position the agriculture sector as a principal engine for human and economic development within an overall national Green Economy or Green Growth strategy (see Box 3). Consistent with these broader concepts, AGG recognizes ecosystems as key productive assets that need to be carefully managed if they are to return a large and enduring set of benefits to society. Sustainable land and resource management are linked to human wellbeing and economic growth in four key ways:

1) **More efficient use of natural resources and inputs:** by growing more food or fiber per unit of land, water, energy, or nutrient, farmers not only reduce their costs but also become more resilient to climate change, price shocks, or other factors that can affect the availability and cost of agricultural inputs. In addition, when farmers use land and water more efficiently, more resources can be set aside for nature conservation or other economic uses. Recent advances in technology and farm management now enable farmers to be far more resource-efficient than a generation ago. However, these gains have not been widely realized in Africa. Currently, the most efficient farmers are 100 times more productive per unit input than the least efficient ones for any given crop. Spreading best practices more widely can result in tremendous gains.
2) **Reduced risk:** Agriculture can be an inherently risky activity in which profitability may be undermined by environmental risks (drought, flood, pest outbreak) and market fluctuations over which farmers have little control. Ecologically based agriculture and land management mitigates these risks in three important ways: a) by reducing the susceptibility of agriculture to extreme environmental conditions; b) by giving the farmers new tools to manage risks; and c) through livelihood and landscape diversification that reduces dependence on any single economic activity.
3) **Increased flows of ecosystem benefits:** Tanzania's industries and urban populations depend heavily on the goods and services provided by healthy ecosystems—from clean water flowing to homes and businesses in Dar es Salaam, to fuelwood for agricultural processing for tea and other commodities, to wildlife supporting Tanzania's tourism industry. Green Growth incorporates the monetary values associated with these benefits into decision-making to ensure that economic development does sacrifice valuable assets.

4) **Reduced negative impacts and environmental damage:** Countries that have pursued conventional intensification of agriculture without due regard to environmental impacts are now needing to spend vast sums of money to fix problems such as erosion, siltation, and groundwater contamination (see Box 1). Closer to home, careful agricultural management can help prevent negative impacts on the health and livelihoods of local populations, such as water pollution, vector-borne diseases, and diminished access to key wild foods and materials.

In short, AGG seeks to conserve and sustainably use natural resources to maximize their benefit for food security, poverty alleviation, and economic development.

While the term *Agriculture Green Growth* is new, the AGG concept incorporates a number of well-proven sustainable farming practices and systems, many of which are very suitable for the Southern Corridor (see Chapter 4). AGG therefore overlaps substantially with other modern concepts of sustainable agriculture, such as climate-smart agriculture and sustainable intensification (see Box 3). But AGG is broader than these approaches in that it coordinates agricultural development with development of other sectors in order to achieve new synergies in support of overall national development ambitions.

Box 3-1. Key concepts and terms related to Agriculture Green Growth

Green Economy refers to economic development that improves human well-being and social equity while reducing environmental risks and scarcities.[10] As a contemporary form of sustainable development, the green economy recognizes the monetary and non-monetary values of ecosystems for human well-being, and incorporates these values into strategic decision-making. A green economy also emphasizes the importance of resource use efficiency, reduced carbon emissions, and inclusive growth benefitting all sectors of society. The Green Economy concept has been championed by the United Nations Environment Programme and adopted in numerous developing countries, including Brazil, Indonesia, Kenya, and Rwanda.

Green Growth is a similar concept that links economic growth and human wellbeing in all sectors (food production, energy, water, transport, housing, etc.) to sustainable resource management. The OECD championed Green Growth in 2009 as a strategy to steer the world's development trajectory toward more sustainable, less risky growth in the wake of the 2008 world financial crisis.[11] The concept has since been incorporated into national development strategies in more than a dozen countries.

Climate-smart agriculture is an approach to food production that sustainably improves productivity, increases resilience (i.e., climate change adaptation), and reduces net greenhouse gas emissions (i.e., climate change mitigation) while enhancing the achievement of national food security and development goals.[12] Major agricultural development and funding agencies (e.g., the FAO, World Bank, IFAD, and many international NGOs) have recently incorporated the principals of climate-smart agriculture into majy of their investments to ensure that agricultural development yields long-term livelihood and food security gains, even in the face of climate change.

Sustainable intensification is a broad term referring to strategies that increase the amount of food produced per unit of land, but without negatively affecting the environment or resource base. Whereas conventional strategies intensify agriculture by applying more chemical fertilizer, pesticides, water, and energy, sustainable intensification does so mainly by improving input use efficiency and promoting ecological processes (e.g., nutrient cycling, soil fertility, water harvesting, pest control, and pollination) that increase the biotic and abiotic productivity of the farm. Sustainable intensification can combine these ecologically-based practices with judicious use of modern technologies and practices, including agrochemicals, hybrid or genetically modified seeds, and modern farm machinery.

[10] Definition of the United Nations Environment Programme.
[11] See "Towards green growth: a summary for policy makers," 2011, OECD.
[12] Definition paraphrased from the FAO. See "Climate-smart agriculture: managing ecosystems for sustainable livelihoods," 2011, FAO.

Investing in Agriculture Green Growth

One important difference between AGG and business-as-usual is that AGG incorporates ecosystem values and social equity considerations into decision-making for public- and private-sector investors. Another key difference is that traditional public and private sector investments are complemented by additional types of investors and investments to stimulate sustainable growth with broad-reaching benefits.

The new calculus for private investment

Under business-as-usual, investment decisions are typically informed by standard financial models and pro-formas, which treat environmental and social factors as "externalities" that are irrelevant to the financial analysis. Historically, private sector decision-makers generally considered such factors only when they were compelled to by public policies and regulations. In recent years, international investors and financial institutions have increasingly signed on to new sets of guidelines for good conduct, such as the Equator Principles, which set minimum standards for the social and environmental impact of investment.

But the calculus for private investment is now changing more radically, as companies come to recognize that environmental and social factors constitute key risks and opportunities for the profitability and long-term viability of their business models (Table 1). For instance, water-efficient agriculture can help companies improve the reliability of agricultural raw material supplies, and reduce the risk that climate change or drought will result in shortages. Precision application of water and agrochemicals can reduce input costs and increase profit. Engagement of rural communities in cooperative food-growing, processing, and marketing ventures can reduce the risk of local conflict around a commercial farm. And improved social and environmental performance of the agricultural supply chain can translate into product differentiation and marketing advantages that can boost market share or price at the wholesale and consumer level.

Table 3-1: The new calculus for private investment. The table indicates key factors in investment decision-making typically included in traditional business decision-making (old model), as well as those factors now increasingly included in decision-making related to investment in land and agriculture (new model).

Old model	New model

• **Risk-adjusted return**
  ○ Capital and operational expenditures
  ○ Discounted cash flow
  ○ Risks (e.g., crop failure, political instability, currency fluctuations)
• **Product differentiation** based on quality and/or marketing
	• **Risk-adjusted return**
	  ○ Capital and operational expenditures
	  ○ Discounted cash flow
	  ○ Risks (e.g., weather, crop failure, political instability, currency fluctuations)
	  ○ Additional risks (e.g., climate change, water scarcity)
	• **Product differentiation** based on quality, marketing, and/or social and environmental credentials
	• Corporate or brand **reputation and image** as a "good business actor"
	• **Market access and "license to operate"** linked to social and environmental performance

The convergence of these factors has contributed to an increasingly robust business case for pursing a Green Growth approach to agricultural investment. In response, investors have begun to use a range of planning and analysis tools to incorporate environmental and social risks and opportunities into investment decision-making.

Types of agriculture green growth investments

AGG is a "triple bottom line" approach to development that prioritizes economic, social, and environmental benefits. It is logical, then, that AGG should attract investors that prioritize each of these outcomes—or combinations of them. By taking a broader view of investment in land and agriculture that includes diverse types of investors, it is possible to increase the total pool of capital available to support sustainable agricultural development while generating new synergies among different investments.[13]

The SAGCOT Blueprint identifies three main pools of capital that will finance agricultural development and supporting infrastructure in the Southern Corridor: private sector investment (projected at US $2.1 billion over 20 years), public sector resources (projected at US $650 million over 20 years), and a multi-donor catalytic fund (projected at US $50 million during the first several years of the SAGCOT initiative). The Blueprint also identifies some innovative ways in which these resources could be combined and leveraged to support early-stage agricultural investment that is critical for jump-starting progress but is typically too risky for market-rate investors. For instance, capital from social impact investors (who seek multiple bottom line results – financial, social, environmental) could be combined with market-rate equity finance to establish a "patient capital" fund to finance local infrastructure.

The Greenprint recognizes four additional sources of capital as critical for investments in AGG (Table 2). These include:

1) **Small-scale farmers and farmer associations:** According to the projections of the SAGCOT Blueprint, commercial farms and outgrowers will comprise up to about 15% of agricultural land in the Southern Corridor by 2030. That means that small-scale farmers and farmer associations unassociated with commercial farms will be the principal investors for 85% of the Corridor's agricultural land. Tanzania has a long tradition of grassroots-led investment in agriculture and rural enterprise through savings and credit cooperatives (SACCOs) and other models. Meanwhile, new sources of debt finance are beginning to serve the smallholder sector and its specific needs. These remain comparatively small, but there is strong potential for expansion.
2) **Civic sector:** The civic sector includes local, national, and international non-governmental organizations. These groups are key investors in agriculture and rural development, as well as catalysts of further investment by small-scale farmers and associations. The civic sector typically prioritizes social and/or environmental returns, usually tied to economic improvement for a target population. Financing for civic sector investments ultimately comes from a wide range of donor and philanthropic sources, including bi- and multi-lateral donors, private foundations, and individual membership contributions. Civic sector groups focusing on agriculture and food security, rural development, health, environment, and other areas are all very active in the Southern Corridor.
3) **A new class of social investors:** The world of social investing has not only grown rapidly in recent years, but also diversified, reflecting the wide breadth of objectives, profit expectations, and sectoral foci of social investors. In addition to those categories of social investors identified in the Blueprint, a new set of sustainable agriculture investment funds is coming online, as described in Chapter 7. More and more international investors and companies are also following sustainability screening criteria, which introduce social and environmental considerations into investment decision-making.

[13] The word "investment" can be used in many different ways. Here, we use the term to refer to financial expenditures or in-kind expenditures (e.g., of household labor) made in anticipation of gaining future economic returns that, when discounted, exceed the amount of the initial expenditure. We also consider "social investments" in which expenditures are made in anticipation of gaining tangible, quantifiable benefits for human or societal wellbeing (but not necessarily financial returns). These different definitions of "investments" reflect the different bottom line criteria by which different categories of investors evaluate and prioritize investment opportunities.

4) **Climate finance:** There is substantial potential for international climate finance to support sustainable agriculture in sub-Saharan Africa. Donors have made commitments totaling US$30 billion per year in 2012 and US$100 billion per year by 2020 for adaptation and mitigation funding throughout the developing world. While institutions in Africa are developing to use these funds efficiently, so far only a small fraction of this potential has been realized. Nationally Appropriate Mitigation Actions (NAMAs)—voluntary mitigation actions pledged by developing countries to receive finance and technical assistance—while not yet functional, appear well-suited to support sustainable agriculture. The primary channel for adaptation finance has been funds linked to the UN Framework Convention on Climate Change, and these have been supplied largely for agricultural projects in Africa. In addition, a growing cohort of private foundations and international NGOs, such as CARE, Oxfam, and Conservation International, are joining with national NGOs and farmer organizations to make climate-focused investments in African agriculture.[14]

> *"Sustainable and broad based growth can only be realised through … widening the spectrum of actors in the economy, particularly the informal sector, SMEs [small and medium enterprises] and the cooperatives."*
>
> --United Republic of Tanzania, National Strategy for Growth and Reduction of Poverty (MKUKUTA)

Inclusion of these additional categories of investors in the SAGCOT strategy will help SAGCOT forge partnerships to overcome hurdles that have so far prevented a blossoming of Tanzanian agriculture. As in the original Blueprint strategy, this will be achieved by co-locating and coordinating investments in agricultural inputs, production, processing, distribution, and infrastructure to ensure that there remain no significant bottlenecks to well-functioning agricultural value chains. Incorporation of smallholder, civic, social, and climate finance investors into the SAGCOT partnership model will provide additional opportunities for investment complementary. For instance, an NGO-led project on crop or livestock development could provide the agricultural raw materials for an energy-efficient processing facility that is financed by private investors but subsidized by a climate change mitigation fund. In this example, the inclusion of investors who do not expect market-rate financial returns helps to fill key gaps in the development of sustainable agricultural value chains. Additional detail on the AGG financing strategy is provided in Chapter 7.

AGG also places a strong emphasis on investments that can complement direct investment in crop and livestock production and processing to achieve the ultimate objective of sustainable food security, landscapes, and rural livelihoods (Table 2). These complementary investments include:

- Investment in other productive sectors, specifically forests and fisheries;
- Investment in distributed rural energy based on biomass and other renewable sources;
- Investment in "natural capital"—that is, functioning ecosystems that provide the basis for economically valuable goods and services such as clean water and nature-based tourism;
- Investment in capacity development, including extension, learning, entrepreneurship training; and
- Investment in research and development for new technologies and practices for sustainable crop, farm, range, and landscape management.

[14] Source: Shames, S., R. Friedman, and T. Havemann. Forthcoming. Coordinating Finance for Climate-Smart Agriculture. *Ecoagriculture Discussion Paper* no. 9. Washington, DC: EcoAgriculture Partners.

Table 3-2: Agriculture Green Growth investors and investments. The table identifies the major categories of investors (table rows) and investment types (the right-most two columns) that can support Agriculture Green Growth. Investor categories and types shaded blue are the focus of the original SAGCOT Blueprint. Those highlighted green are additional investor categories and types included in the Greenprint to expand the total flow of capital and foster new inter-sectoral partnerships.

Investor category (sector)	Sources of funds	Investment types	
		Agriculture production, value chains, and infrastructure	Supporting investments in agriculture and other sectors
Government of Tanzania (public sector)	• General revenue • Development partner support	• Roads and rail • Irrigation • Power grid • Agricultural research	• Capacity development • Natural capital
Tanzanian and foreign companies (private sector)	• Company's capital • Conventional equity and debt financing • Social & patient capital	• Agricultural production • Agricultural storage, processing, distribution, and marketing	• Forests, rural energy, fisheries • Natural capital
SAGCOT catalytic fund (quasi-public sector)	• Development partners	• Agricultural production • Agricultural storage, processing, distribution, and marketing	• Forest, rural energy, fisheries • Natural capital
Small-scale farmers and associations (private sector)	• Individual or association capital • Debt financing from lending institutions • Social & patient capital	• Agricultural production • Agricultural storage, processing, distribution, and marketing	• Forests, rural energy, fisheries • Natural capital
Various civic sector investors (civic sector)	• Philanthropic sources	• Agricultural production • Agricultural storage, processing, distribution, and marketing	• Forests, rural energy, fisheries • Natural capital • Capacity development
Additional social investors (public, private, civic, or hybrid)	• Foundations and donors • Quasi-public funds • Individual investors	• Agricultural production • Agricultural storage, processing, distribution, and marketing	
Climate finance (public, private, civic, or hybrid)	• Private companies • Multi-lateral agencies/donors • Development partners	• Climate-smart agriculture • Projects to reduce agricultural greenhouse gas emissions • Projects to reduce deforestation by intensifying agriculture	

Agriculture Green Growth Outcomes and Beneficiaries

At its core, AGG is an approach to achieving the objectives of Tanzania's high-level policy priorities for food security, poverty alleviation, and sustainable development—including MKUKUTA and *Kilimo Kwanza*—through public-private-civic partnerships. As such, the AGG strategies in the Greenprint are

identified and prioritized according to their potential to provide benefits for four key groups: 1) small-scale farmers; 2) private companies and investors; 3) rural communities; and 4) the United Republic of Tanzania as a whole. These benefits accrue through several 'pathways' linked to the focus of AGG on climate-smart agriculture, resource use efficiency, risk reduction, capacity development, economic diversification, and inter-sectoral harmonization (Table 3).

As noted above, AGG is also rooted in concepts of sustainable development and Green Economy that evaluate growth based on its economic, social, and environmental benefits (or harms). A major focus of this document is on linking environmental benefits to both short- and long-term economic and social gains. However, the Greenprint also recognizes that the Southern Corridor is home to numerous ecosystems, plant species, and animal species that are globally rare, significant, and threatened. AGG seeks solutions that prioritize development in harmony with this natural heritage that is unique to Tanzania, and irreplaceable.

Table 3-3: Agriculture Green Growth beneficiaries and key benefit pathways. The table identifies some of the principal ways in which an AGG approach can generate benefits for key stakeholders at multiple scales.

AGG Beneficiaries	Key AGG Benefits
Small-scale farmers	• Increased agricultural yield and income • Improved health and nutrition • Improved livelihood security and resilience
Private-sector companies (investors)	• Increased profitability • Reduced risk • Long-term sustainability of their resource base
Rural communities	• Greater food security • Improved human development (health, education, welfare) • Reduced conflict among land and water users • Increased diversification of local economies • More secure access to water, energy, wild products
United Republic of Tanzania	• National food security • Expanded export agriculture sector • Agriculture contributes significantly to national development objectives (e.g., MUK…) • Agricultural development supports, and does not inhibit, development of other economic sectors • Improved "natural capital" as the base for continued sustainable economic development

4. Agriculture Green Growth in Action

This chapter and the next one are the heart of the Greenprint. They present the specific practices, investments, and programs that will need to be adopted and promoted to mainstream Agriculture Green Growth and its benefits throughout the Corridor.

In implementing AGG for SAGCOT, there is no need to "reinvent the wheel." An abundance of proven AGG strategies—ranging from soil management practices to innovative finance and benefit-sharing models to environmental monitoring tools—are already in use in the Corridor, in other parts of Tanzania, and in other regions of Africa and the world. Rather than start from scratch, most efforts to roll out AGG for SAGCOT can focus on selecting from among these winning strategies and adapting them to the unique contexts of the Southern Corridor.

Similarly, there is no need to re-hash the many excellent recommendations and action steps presented in the Blueprint. Many of these are referenced here, but the focus of the Greenprint is on complementary practices and strategies to ensure that agricultural development leads to permanent food security gains, and that it is climate-smart, environmentally sustainable, and synergistic with development of other key economic sectors.

With this in mind, Chapter 4 focuses on a set of "best bet" AGG opportunities that are ready for scaling-up in the Southern Corridor. These opportunities include agriculture, land management, and value chain practices and investments that are economically viable (for one or more categories of investor), socially and environmentally beneficial, and suitable for large-scale implementation in the Corridor. The best bet opportunities are presented below in three groups:

- Sustainable crop and livestock intensification
- Investments in forests, water, and bioenergy
- Value addition and value chains

While this chapter focuses on best bet opportunities, it also identifies additional opportunities that appear promising but require additional research, testing, or improved enabling conditions to be ready to scale-up in the Corridor.

Sustainable Crop and Livestock Intensification

Without intensifying crop and livestock production in the Southern Corridor, it will not be possible to meet food production and food security targets or to arrest and reverse the region's tragic trends toward environmental degradation. Currently, average yields for major grain crops are very low. Across the 42 districts wholly or mainly within the Corridor, maize yields average less than 1.5 tons per hectare and paddy yields less than 2.3 tons per hectare.[15] Smallholder yields are even lower, with maize production averaging around one ton per hectare. In the livestock sector, the number of animals is increasing without improvements in efficiency, leading to degradation of rangelands and increased competition for seasonal water resources. If yields remain static, at least 550,000 hectares of additional land in the Southern Corridor will need to be converted to agriculture over the next twenty years, simply to meet the subsistence food needs of the Corridor's growing population. This scenario would have enormous negative impacts on the region's biodiversity, escalate conflicts over land and water, and significantly

[15] Data from the Tanzania Ministry of Agriculture, Food Security and Cooperatives, mean data from 2005-2010. By comparison, maize yields average 2.1 tons/ha Africa-wide, 4.7 tons/ha in South Africa, and 9.6 tons/ha in the United States. Rice yields average 2.5 tons/ha Africa-wide, 3.5 tons/ha in Madagascar, 5.3 tons/ha in Vietnam, and 7.5 tons/ha in the United States.

increase the Corridor's greenhouse gas emissions—all without satisfactorily addressing national food security. Intensification of agriculture—increasing yield per unit area—is thus not only for food security but also for conservation and climate change mitigation.

Conventional agricultural intensification entails the production of more food per unit of land—often achieved by increasing inputs of water, agrochemicals, labor, and capital. Sustainable intensification also increases food production per unit area, but ensures that the increased use of inputs and intensive management practices neither over-extends local resource stocks (e.g., water or soil nutrients) nor pollutes or degrades the environment (e.g., through erosion and chemical runoff). Sustainable intensification achieves these gains by adhering to the following principles:

1. **Healthy soils:** Soils are managed to maintain organic matter, soil biological activity, and soil nutrients that nurture productive crops, while minimizing erosion.
2. **Efficient use of inputs:** Water, nutrients, and other inputs are applied at the optimal times and locations to nourish crops, while minimizing loss to the environment. Efficient cropping systems are also less susceptible to climate change and fluctuations because they operate more comfortably within the bounds of the local environmental conditions to sustain rewarding crop and livestock yields.
3. **Continual farm monitoring and adaptive management:** To achieve the precise management of inputs, crops, and livestock, farmers must collect and use data on farm heterogeneity (e.g., variations in soil quality or moisture availability) and on changes in farm conditions (e.g., weather, plant health, pest populations).
4. **Closed-loop systems:** To the extent possible, farms should recycle energy, nutrients, and biomass through integrated systems (e.g., crop-livestock-fish), composting, bioenergy generation, and other practices. Doing so reduces input costs as well as waste.
5. **Complementarity:** Sustainable intensification often involves combining external inputs with ecological management of on-farm assets. For instance, mulching, composting, cover crops, and organic fertilizers can all improve soil quality and structure, while chemical fertilizers can boost macronutrient availability and rectify micronutrient deficiencies when necessary for optimal plant growth. Examples of such complementary strategies include integrated pest management and integrated nutrient management.
6. **Diversification:** The above principles are usually best achieved by diversifying farm management through crop rotations and/or spatial diversification of crops, livestock, and trees. This principle does not preclude large-scale commercial agriculture.
7. **Local adaptation and experimentation:** Sustainable intensification can rarely be achieved by following generic prescriptions. Rather, farmers must have the knowledge and tools available to enable them to combine and adapt the right practices for their local environment. Similarly, ongoing farmer experimentation—often through farmer groups—enables farmers continually to improve their agriculture and respond to changing conditions.

As these principles imply, sustainable intensification may be achieved through a diversity of means, ranging from the application of modern technology, seeds, and machinery to the strategic management of farm ecosystems to improve water and nutrient cycling, pest control, and other critical processes. Rather than choose one sustainable intensification method over another, the Greenprint advocates an "all of the above" approach that supports farmers to select and adapt appropriate practices from a large toolbox.

The AGG planning process identified four "best bet" sustainable intensification strategies for the Southern Corridor that are capable of generating significant benefits for yield, profitability, and

environmental performance: conservation agriculture, System of Rice Intensification, precision agriculture, and sustainable livestock intensification. Each of these strategies is explained briefly here and analyzed in greater depth in the Opportunity Analyses in Annex B.

> *"We need to double the efficiency of every agricultural input, including water, fertilizer, pesticides, energy and infrastructure. The technology exists to do this, and the best producers can already achieve these results."*
>
> *--Jason Clay, WWF*[16]

Conservation agriculture

Conservation agriculture (CA) is a farming system that includes three core practices: 1) minimizing tillage and other soil disturbance, 2) maintaining permanent soil cover, and 3) diversifying crop rotations. By reducing soil disturbance and improving water and nutrient availability to crops, CA can increase yield, improve drought resistance, and reduce environmental impacts. Profitability often increases as a result of lower input and/or labor costs, combined with higher yields. CA can be used for a wide variety of grain and horticulture crops grown in the corridor including maize, sunflower, beans, peas, sorghum, and vegetables. It is readily adapted to both small- and large-scale farms.

CA is already in use in the Southern Corridor, but not at a large scale. However, worldwide it has been applied on more than 100 million hectares, and CA has already been mainstreamed in diverse contexts including for smallholder agriculture in Zambia and for large commercial grain farms in Brazil, Eastern Europe, and North America. If applied at scale across the Southern Corridor, CA could yield hundreds of thousands of tons of additional grain output, while potentially reducing water use and increasing carbon storage in agricultural soils. (Please see Annex B, Opportunity Analysis #1, for further details and illustrative calculations.) The most important need for scaling-up CA is a concerted extension program emphasizing CA practices through participatory training approaches (e.g., through Farmer Field Schools). The proposed AGG extension strategy is discussed in Chapter 5. In addition, improved access to inputs and CA machinery is needed to enable uptake by both small-scale and large commercial farms.

System of Rice Intensification and improved rice agronomy

System of Rice Intensification (SRI) is a method for increasing the productivity of irrigated rice by changing the management of plants, soil, water, and nutrients. Compared to conventional rice cultivation, SRI involves intermittent water application (as opposed to continuous flooding), lower plant densities with regular spacing, and reduced use of chemical fertilizers and pesticides. These practices improve soil structure and functioning, facilitate root growth, and ultimately produce more robust rice plants with higher grain yields. SRI is best suited to small-scale rice farming, and can be applied either as an organic system or with judicious application of agrochemicals.

SRI benefits have been widely documented, and include a 50-100% (or greater) yield increase, up to 90% reduction in required seed, up to 50% water savings, and substantial gains in profitability.[17] In addition, SRI rice is generally more drought-resistant and able to resist storm damage because of better root systems and more robust canopies. It is also more resistant to pests and diseases.

SRI has been applied successfully in nearly 50 countries, including neighboring Kenya, Mozambique, Rwanda, and Zambia.[18] Where SRI has received policy and program support, it has scaled up rapidly and contributed greatly to food security and economic development. For instance, after Vietnam's Ministry of Agriculture and Rural Development officially endorsed SRI in 2007, the number of farmers using the

[16] From the article "Freeze the footprint of food," Nature 475: 287-289, 2011.
[17] Africare, Oxfam, and WWF. 2010. More rice for people, more water for the planet. WWF-ICRISAT project, Hyderabad, India.
[18] For more information on these experiences, please see http://sri.ciifad.cornell.edu/countries/index.html.

practice grew from less than 10,000 to more than one million over the course of four years. In Sichuan Province, China, SRI has expanded to more than 300,000 hectares, yielding an additional 1.66 million tons of paddy rice valued at over US $300 million.

Within the Corridor, in 2009 Kilombero Plantations Ltd. (KPL) piloted an SRI program for smallholders in the communities surrounding their Mngeta farm. The program provided improved seed and extension services. Within the first year, paddy yields rose from 2-3 tons per hectare to 5-8 tons per hectare. With support from KPL and USAID, the program is expanding to 1,350 new farmers in 2012 and a projected 4,000 total farmers by 2013. Because SRI does not require major capital investment or even access to full-service input supply chains, it is ripe for scaling-up in most rice-growing regions of the Southern Corridor. That said, farmers do need access to equitable rice value chains to enable them to benefit from surplus production that is likely to result from SRI adoption. In Dodoma, SRI technology and improved value chains are being implemented through the USAID-supported Nafaka program. Additional priorities for scaling up SRI are identified in the SRI Opportunity Analysis in Annex B.

Precision agriculture

Precision agriculture (PA) uses a suite of tools and technologies to optimize the application of agricultural inputs (e.g., water, fertilizer, and pesticide) to ensure good crop health, improve input use efficiency, and reduce waste and pollution. Farmers who apply precision agriculture conduct real-time monitoring of heterogeneity in water availability, nutrient availability, and pest problems across their fields to ensure that inputs are applied in the right place at the right time. The term *precision agriculture* usually refers to large farms using modern information technologies such as laser leveling for field preparation, GIS yield monitoring and mapping, and GPS-guided farm machinery.[19] However, the basic principles of precision agriculture can be equally well applied using simple evaluation protocols (such as leaf color charts) and technologies (such as drip irrigation) on small farms.

Precision agriculture has been widely adopted on large commercial farms with adequate capital to invest in the requisite machinery and technology. For instance, as of 2006, 45% of land planted to soy in the United States used GIS yield monitoring technology while 35% used variable rate input application technology.[20] When it is applied on commercial farms that already have high yields, precision agriculture does not tend to increase yield significantly, but it does reduce input use, thereby lowering farmer cost, boosting profitability, and reducing pollution.[21] When precision techniques are applied on smallholder farms using traditional, unimproved practices, significant yield gains may be expected due to improved plant health and the elimination of key water and nutrient deficiencies, with affordable levels of inputs. For additional information, please see the Opportunity Analysis #3 in Annex B.

As the incremental cost of precision agriculture equipment falls, the economic rationale for investing in the technology improves. In the Southern Corridor, as new large-scale farms come online, policies and incentives should be put in place to encourage the adoption of precision agriculture technologies that reduce water use, greenhouse gas emission, and pollution. Such policies include easing any existing restrictions on import of machinery needed for sustainable production, charging appropriate user fees for water, and instituting AGG guidelines for clean, efficient agriculture (see Investment Guidelines in Chapter 5). The Catalytic Fund could also be considered as a source of finance to help companies

[19] Geographic Information Systems (GIS) are software platforms for organizing and analyzing spatial data. Geographic Positioning Systems (GPS) use mobile devices used to record the user's position on Earth. GPS-driven machinery is able to follow or apply inputs precisely according to a pre-programmed location-based protocol.
[20] Ebel, R., and D. Schimmelpfennig. 2011. The Information age and adoption of precision agriculture. Economic Information Bulletin Number 80. United States Department of Agriculture.
[21] Based on the review conducted by Milder et al. 2012. Moving beyond ideology to close yield gaps and "nature gaps" in 21st century agriculture. Report to the Bill & Melinda Gates Foundation.

overcome the initial investment hurdle of acquiring PA machinery and technology that would yield long-term dividends in terms of yield, profitability, and reduced environmental impact.

Sustainable livestock intensification

The potential for sustainable intensification of livestock production in the Southern Corridor is enormous. Tanzania has one of the largest livestock herds in Africa, occupying vast areas of land, in increasing conflict with other land uses. Yet, more than 90% of the nation's cattle, sheep, and goats are unimproved breeds that provide low yields and inferior meat quality; and limited value addition of animal products further diminishes the livestock sector's economic output. Sustainable intensification of livestock involves the production of more meat of higher quality, with less total input of land and water. These outcomes result from better range management and restoration of degraded lands, appropriate stocking rates, improved livestock breeds, improved livestock health, supplementary feeding of grain or fodder crops at critical lifecycle stages, and efficient, humane and environmentally safe slaughter and processing facilities.

In the Southern Corridor, sustainable livestock intensification is feasible for beef, dairy, and small livestock in the context of large ranches, pastoralism, and smallholder mixed farming. Large cattle ranches with integrated production and processing operations offer a best-bet opportunity to sustainably intensify beef production, with synergistic benefits for smallholders and pastoralists. Currently, the Corridor contains four large, underperforming ranches owned by the National Ranching Company (NARCO). Total current stocking on these ranches is about 16,000 head of cattle, but carrying capacity with proper range management, rotation, and animal management is up to 50,000 head for grassfed production, or several times more for feedlot-based systems. These ranches provide near-term opportunities for sustainable intensification that could simultaneously maintain or enhance range conditions and provide market hubs for supporting small-scale livestock producers.

Key supporting strategies

The Blueprint already includes many strategies that can support sustainable intensification. For example, weather insurance for smallholders—also known as microinsurance—is identified as a key tool for reducing the risk profile of smallholder farmers and allowing them make investments in sustainable technologies, new crop varieties and fertilizers. Similarly, boosting smallholder production depends on guaranteed access to fertilizer. The nucleus farms and small and medium-sized agribusinesses identified in the Blueprint serve as primary sources for fertilizer and other inputs. Microinsurance and improved access to inputs work hand-in-hand to aid farmers in obtaining financing for and access to seeds for drought-resistant and improved drop varieties. For farmers unaffiliated with nucleus farms, producer associations will play a key role in promote smallholder access to land, inputs and seeds.

Other promising opportunities

The four "best bet" sustainable intensification strategies above cover most of the key cropping and livestock systems in the Corridor. But they are by no means an exhaustive list. Other sustainable intensification strategies are already being applied successfully in southern Tanzania, albeit on a small scale. Others are in earlier stages of development but show promise. Additional sustainable intensification strategies that merit further research and/or investigation as to their suitability for scaling-up include:

- **Horticulture in mixed farming systems:** Demand for horticultural products for domestic consumption is increasing due to changes in dietary preference. This trend toward nutritional diversity is a positive one, and creates new market opportunities for vegetable producers. Because of perishability concerns, a distributed network of horticulture producers is often most efficient. Horticulture crops tend to yield much higher revenues per unit land area or unit of irrigation water than grain crops. They also benefit strongly from on-farm nutrient sources such as compost, small

livestock manure, or residues from biogas digesters. Horticulture is therefore often a synergistic part of a mixed farming system. It is also an important side crop that can help maintain good nutrition for smallholders who become outgrowers and shift to producing a single cash crop.

- **Integrated crop/livestock and crop/aquaculture systems:** Integrated crop-livestock systems take advantage of resources that most smallholders have on-farm to boost both crop and livestock production through nutrient recycling. Closing the loop for efficient nutrient cycling allows farmers to intensify production without purchasing additional inputs or using more land. In these systems, crops function as food, fodder and mulch while livestock produce meat, dairy products and fertilizer. Another option, for farms with access to ponds and small dams, is integrated livestock-aquaculture systems, where livestock waste serves as nutrient-rich fish food. Integrating farm systems often establishes synergistic relationships which will generate benefits to productivity, income and household nutrition.
- **Agroforestry for food security and income generation:** Agroforestry involves the integration of trees into cropping and livestock systems to provide multiple benefits including fruit, nuts, fodder, fuelwood, and fertilizer from nitrogen-fixing trees. Many forms of agroforestry are already in use in the corridor, and could be used much more widely to help farmers diversify their income, increase resilience and guard again crop failures, and increase carbon sequestration throughout the region. One opportunity with widespread applicability in the Corridor is fruit tree agroforestry. Currently, fruit trees exist on many small farms in the Corridor and provide a food security "safety net" with particular importance for women and children, who typically participate less in the cash economy. Fruit tree agroforestry could be readily intensified through sharing of new species and varieties, community nursery projects, and training in establishment, management and marketing of fruit crops.
- **Biochar:** Biochar is a type of charcoal that is used as a soil amendment to increase soil fertility. Inspired by discovery of the productive "dark earth" soils of the Amazon Basin and West Africa, which were amended with biochar thousands of years ago to support agriculture, scientists are now investigating the role of biochar in supporting sustainable agriculture and carbon sequestration. Because it helps increase plant nutrient availability in low-fertility soils, biochar is considered a promising amendment option for nutrient-depleted soils found throughout much of sub-Saharan Africa. In addition, because biochar is a stable form of carbon, it has the potential to sequester soil carbon for hundreds to thousands of years, potentially making it a major contributor to climate change mitigation. Pyrolysis, the process used to make biochar, results in additional energy products such as bio-oil and syngas. Because of its multiple applications for soil improvement, waste management, energy production and climate change mitigation, biochar should be further explored and pilot-tested as a promising innovation for the Corridor.

Investments in Forests, Water, and Bioenergy

As emphasized throughout the Greenprint, natural resources such as water and forests underlie the Southern Corridor's long-term wellbeing and prosperity, particularly for agricultural development. Energy is an additional resource that, for the foreseeable future, will be derived mainly from biomass sources; thus, any energy strategy must by necessity interwoven with issues of land use, deforestation, and biomass management. Historically, forests and water tended to be exploited by the private sector with little view toward long-term sustainability; protection for such resources, to the extent it existed, came from the public sector. In contrast to this approach, a central premise of Green Growth that forests, water, and other critical resources are "investable assets" that are the focus of private sector investment. Such investment seeks to maintain and increase the productive capacity of the resource, thereby supporting off-take (e.g., forest harvest) that can be sustained indefinitely—as opposed to one-time exploitation. Private investment is not a substitute for well-designed and managed protected areas and regulatory and

governance systems. But it is essential for improving the management of the two-thirds of the Corridor that is not designated as a conservation management area.

An enterprise approach to community forestry

[This strategy will be summarized in the final report.]

Payment for ecosystem services

In Tanzania and throughout the world, the people and communities who manage important natural resources are being compensated for their efforts through programs of payment for ecosystem services (PES). PES is a market-based approach in which beneficiaries of ecosystem services—such as water users and conservationists—pay the providers of these services to sustain healthy ecosystems and thereby ensure continued service flows. In rural landscapes, PES approaches have most commonly been applied for three services: 1) maintaining clean and abundant water, 2) sequestering carbon in soils or plants, and 3) conserving plant and animal species, or the habitats they use. Within the Corridor, for instance, a pilot PES scheme in the Uluguru Mountains compensated farmers to plant trees, install terraces, and conduct other practices to reduce siltation into a tributary supplying water to Dar es Salaam. In other parts of the Corridor, a series of REDD+ pilot projects are currently being implemented to provide rural communities with payment for "carbon credits" generated by reducing deforestation and more effectively managing community forests. An additional example—while not strictly a PES project—is illustrative of the "business case" for PES for commercial farms. In Kilombero Cluster, a major rice estate (Kilombero Plantations, Ltd.) has enlisted (and is supporting) a Tanzanian NGO to assist upstream communities in more effectively managing forests, both for income generation and for ensuring clean, abundant supplies of irrigation water.

Because PES is voluntary on the part of both the buyer and seller of ecosystem services, it is typically a win-win transaction in healthy ecosystems are conserved while the payment recipient receives funds that at least fully compensate any foregone revenue associated with the conservation activities. These above examples illustrate three prime rationale for scaling-up PES in the Corridor:

1) PES can be the most cost-effective way of protecting critical "public goods" such as reliable water supplies for cities or hydroelectric dams.
2) PES is a principal mechanism by which farmers and rural communities can participate in global carbon markets, receiving incentives for managing carbon-rich landscapes.
3) PES can help a range of companies—from farm estates to bottling plants—ensure reliable future supplies of key production inputs, thereby reducing risk in a cost-effective way.

As users of ecosystem services consider the above rationale, PES may be adopted spontaneously in areas of the Corridor where it is feasible and economically efficient. SAGCOT stakeholders (particularly conservation organizations) can also play a role in identifying places where PES is likely to be especially worthwhile, and connecting the parties to organizations that can set up PES schemes. Additionally, the GoT, through its climate change planning work, may consider the opportunity to develop REDD+ projects and earn carbon credits through the significant amount of avoided deforestation anticipated under the Greenprint strategy (see Chapter 9).

Bioenergy

Modern energy services are largely provided from a central grid for electricity or piped natural gas. For most rural communities in southern Tanzania, however, centralized power is not likely to become available, even under the ambitious SAGCOT goals. With likely price increases for fossil fuels over the next few decades, even transportable fuels such as diesel and kerosene will become increasingly costly. An alternative to producing power centrally and building large-scale transmission infrastructure to deliver

it is to produce energy locally and distribute it through small-scale networks. This approach is not only cleaner; it may also be more reliable to ensure that power is available when it is needed for purposes such as pumping irrigation water and maintaining cold storage for food distribution networks. At a national level, development of alternative clean energy sources to compensate for future decreases in hydroelectric potential is identified as a priority area in Tanzania's National Adaptation Programme of Action (NAPA).

One particularly suitable fuel for the Southern Corridor is biogas, produced through the decomposition of organic waste, such as manure or agricultural residues, in a biodigester. Among other advantages, biogas may be generated from multiple and variable fuel sources, may be stored until it is needed, is fully scalable from household to industrial applications, and generally produces no net greenhouse gases. In fact, in some contexts, biogas systems result in net emissions reductions.

There are already many businesses in the Southern Corridor involved in biogas production at the farm and household levels. In addition, a number of companies that build and distribute biogas systems are interested in conducting or scaling-up business in the Corridor. Below are a few examples that illustrate the types of innovations—and the scale of possible impacts—that are possible.

One company, Simgas, sells biodigesters that are mass-produced in Tanzania, portable, and scalable. For household application, Simgas provides loan financing for buyers payable over the course of 18 to 36 months. The company estimates that microfinance investment in the range of $80 million to $190 million, deployed through a revolving finance scheme over a 20 year period, could enable 200,000-300,000 rural households in Tanzania to acquire a Simgas system. At this scale of uptake, the participating households would realize a total energy cost savings of $1.5 billion over 20 years, while preventing the harvest of 25 million tons of wood (the equivalent of about 675,000 hectares of standing forest) and decreasing carbon emissions by about 30 million tons of CO_2-equivalent.

Conventional biogas technology has impurities that limit the scale of power. An international company, Emergence BioEnergy, Inc, has developed a franchise package known as the EBI Utility Station or EBUS, that an entrepreneur owns and operates to provide reliable energy to rural consumers. The EBUS uses cow manure to produce energy in a micro-combined-heat-and-power (micro-CHP) unit. A ten-cow operation can generate one kilowatt on a continuous basis. The EBUS adopts a "waste-nothing" approach generating six streams of revenues that are intended to triple the overall return of small dairy farms. These six revenues—which include electricity, milk, refrigeration, fertilizer, methane credits, and electrified commercial space—leverage natural synergies in both farm production and product marketing. The company also offers a village-sized EBUS model sized at 4 kilowatts (40 cows) that is large enough to power irrigation pumps and small agro-processing enterprises or refrigeration for dairy facilities (cooling 250 liters of milk). Where it is being tested in Bangladesh, the investment cost is $10,000, with a payback on dairy farms in only 18 months.

Finance is currently a key missing ingredient that limits uptake of bioenergy systems. However, because of its short payback period, low risk, and compelling co-benefits for poverty alleviation, climate change mitigation, and ecosystem conservation, there is the potential for many commercial as well as social investors to be attracted to this space. For instance, funding for biogas digesters and village/enterprise-level bioenergy may be available from the international "Sustainable Energy for All" initiative that was launched in June 2012 at the United Nations Conference on Sustainable Development (Rio+20). In addition, USAID is providing $300,000-$1,000,000 grants through its "Powering Agriculture" initiative, which SAGCOT partners could potentially access to test innovative energy solutions.

Improved water management

Improved water management is widely acknowledged as being critical to the future of Tanzania's agriculture sector, particularly in light of projected changes in the climate. Irrigation and water management are highlighted as top priorities in the ASDS, ASDP, and NAPA, among other high-level policy strategies. Investment in improved water management ranges from simple changes that farmers can make themselves with no capital requirements, to costly infrastructure with longer payback periods. In the section on sustainable intensification, above, several strategies for improving water use efficiency were highlighted. Some of these (such as precision agriculture) could be designated as explicit foci of social investment funds, such as the multi-donor SAGCOT Catalytic Fund. Here, we highlight water harvesting and irrigation improvements as two additional priority areas for investment.

In the Southern Corridor, as in most of sub-Saharan Africa, the vast majority of crops are produced in rain-fed systems. The annual total rainfall in much of the Corridor is great enough to support a wide range of crops under rain-fed conditions. However, the seasonal variability of the water supply—which is expected to increase with climate change—presents a major challenge for farmers. Currently, it is estimated that nearly 70% of rainfall is lost to surface runoff. Rainwater harvesting (RWH) provides a range of solutions for capturing, storing and redirecting this runoff for agriculture, livestock and domestic use. Besides increasing yields in rain-fed systems, RWH also mitigates against crop failure during dry periods. The most common methods of RWH include contour farming and ridging, the use of pits and bunds in various configurations, and positioning of fields to capture water sheeting off a hillside. The method employed depends on the crop, soil, labor and capital available to the farmer. In many cases, RWH is supplemented by storage units such as dams, pans or larger reservoirs. Such storage units allow farmers to redistribute erratic rainfall evenly throughout the growing season or even extend the growing season into drier parts of the year.

RWH has been used successfully to improve yields in semi-arid watersheds in northern Tanzania. In the Makanya watershed, for instance, farmers implementing RWH saw yield increases of more than 1 ton per hectare. Under optimal conditions, RWH can increase maize yields by a factor of four; however, when labor inputs for RWH are considered, the returns on labor rarely show an overall benefit. The exception is for high-value crops such as onions and tomatoes, which demonstrate both higher yields and higher returns on labor from RWH.

Irrigated agriculture represents a much smaller area of the Corridor, but supports some of the most important commercial crops, including rice and sugarcane. Many irrigation schemes exist throughout the Corridor for smallholders, block and contract farmers, and large commercial farms. The majority are traditional irrigation systems that divert water from streams onto cropland. These systems, while inexpensive, tend to be highly inefficient. In most cases, only 20-60% of the water diverted from the stream will remain in the field. Old systems may be even less efficient due to leaks in pipes and culverts. In practice, governance of irrigation is Tanzania is quite weak, but there is potential to improve this situation through participatory systems. The Water Resources Management Act and the Water Supply and Sanitation Act, both passed in 2009, establish policies for access to water resources and priorities for water use, and delegate irrigation governance to water user associations (WUAs). WUAs are granted the right to establish bylaws and enforce compliance to ensure fair access to water resources for domestic and socio-economic purposes. The Ilonga WUA in Kilosa District has been successful at bringing community leaders across the basin together to supervise water use for improved crop and livestock production as well as improve water quality by educating local communities. This has been achieved through a number of strategies, including planting of appropriate tree species along waterways, practicing conservation agriculture, keeping records of water use and users and implementing RWH where possible. With additional training and backstopping, the WUA model shows considerable promise to leverage local action to increase water use efficiency. For maximum benefit, WUAs will need access to additional

finance and technical assistance, and must be part of a broader basin management strategy that addresses water allocation issues that transcend the purview of individual WUAs.

Value Addition and Value Chains

Supporting whole value chains and value adding activities is crucial for guaranteeing that the benefits of the cluster development approach reach all stakeholders. Under Agriculture Green Growth, support for entire value chains and promoting value addition become even more important as processing facilities, transportation and marketing for the substantial additional production projected to come from unaffiliated smallholders across the Corridor. The Blueprint already makes many recommendations for capturing added value in the clusters through processing facilities available to smallholders via outgrower schemes, smallholder producer associations which give smallholders greater power in the market, and regional storage and processing facilities that decrease the distance of unaffiliated smallholders to end markets.

Local businesses

Small and medium enterprises are needed to bridge the gap between smallholders and larger markets. This link in the value chain is the ideal position for many local Tanzanian businesses to support sustainable intensification by supplying smallholders with valuable services and putting market outlets in place, while capturing value that can be reinvested in local development. The Southern Highlands Agricultural Development Company Limited (SHADECO Ltd.), a sunflower processor in Iringa Region, is one such business that supports sustainable intensification of sunflower by processing seeds for oil and seed cakes sold. By offering value-adding services, the company supports smallholders who are shifting sunflower under changing climatic conditions and driving improved seed production in order to meet the quality standards for their own markets. Other local businesses could play similar roles in stimulating growth while encouraging sustainable production practices that improve product quality along entire value chains.

Differentiated markets and eco-certification

As noted in Chapter 3, agricultural markets are beginning to place value not just on the relative quality of agricultural products but also on the environmental and social performance of production and processing. Many farmers and food processors in the Southern Corridor adhere to high standards of quality and sustainability, but to be able to benefit financially from these practices, they need a way to distinguish their superior products in the marketplace. This is the role of differentiated markets and eco-certification—including organic production standards; agricultural product standards for internationally traded goods (e.g., GAP standards); requirements exporting bodies; private sector standards, such as sourcing guidelines of international food companies; and third-party eco-standards, such as Fairtrade, Rainforest Alliance, and Forest Stewardship Council.

Compliance with such standards can offer a significant business opportunity for producers in the Southern Corridor by: 1) enabling them to receive price premiums for their products; 2) increasing access to foreign markets or niche markets; and 3) ensuring more stable or guaranteed demand for their products. The Corridor has more than 35,000 hectares of high-value horticulture, coffee, tea, cocoa, and other crops currently under organic production, engaging more than 41,000 farmers, mostly through outgrower schemes. Rainforest Alliance certification has recently been granted for 20,000 cocoa farmers in Kyela district and thousands of hectares of Unilever tea estates in Mufindi district. These certifications have helped to conserve biodiversity, protect critical water supplies, sustain a woodfuel resource for tea drying, and increase income for small-scale farmers and farm workers.

Eco-certification and market differentiation holds significant potential for the Southern Corridor, and is among the best ways to link small-scale farmers to lucrative export markets for key crops. The most

promising opportunities are for fruits, vegetables, tea, coffee, and cocoa (see Quick Win 3). In the longer term, differentiation of staple grains based on quality and sustainability is possible, and has succeeded in neighboring Zambia and elsewhere. There was particular interest during the AGG Leaders Workshop in pursuing eco-standards for rice. See Opportunity Analysis #5 in Annex B for additional information.

Key supporting strategies

Improvement in transportation infrastructure is widely acknowledged as a priority for improving access to markets, reducing cost of transport, and increasing timely access to farm inputs. While development and upgrading of trunk roads is very important, in many areas the greatest need is for "last mile" infrastructure to farm gates. A range of creative options should be explored for leveraging limited resources to furnish and maintain such infrastructure. For instance, many communities in the Corridor have chosen to invest their own manual labor in upgrading feeder roads to facilitate access. The government and partners could develop a more systematic "sweat equity" initiative in which communities willing to invest their own labor are provided with durable materials (such as metal culverts) and technical assistance to upgrade feeder road segments.

Rehabilitation of the TAZARA rail line that connects Dar es Salaam to Zambia will be an additional key investment for improving market linkages and reducing transport costs for many producers and processors. Shifting cargo from road to rail mode will also reduce upkeep expenditures on the main haul roads and reduce greenhouse gas emissions associated with transport of agricultural products. In developed countries, rail transport of bulk commodities is generally three to five times more fuel efficient than truck transport.[22] In the Southern Corridor, this ratio is likely even higher because variable road quality requires that trucks operate at low speeds and with greater variation in speed, both of which tend to lower fuel economy.

[22] Federal Railroad Administration. 2009. Comparative evaluation of rail and truck fuel efficiency on competitive corridors. http://www.fra.dot.gov/Downloads/Comparative_Evaluation_Rail_Truck_Fuel_Efficiency.pdf. Rail efficiency ranges from about 300-500 ton-miles per gallon of fuel, while truck efficiency is around 100 ton-miles per gallon.

5. Creating Fertile Ground for AGG

As highlighted in the preceding chapter, there are numerous ripe opportunities for agriculture-led Green Growth throughout the corridor. However, scaling up such profitable, sustainable activities from isolated examples to mainstream practice requires creating a fertile environment for investment and innovation in which AGG is widely known, economically attractive, and affirmatively supported by government and civil society. This "enabling environment" includes public policies, public infrastructure investment, regulation, incentive structures, technical assistance, and other components.

At present the enabling environment in the Southern Corridor includes many positive aspects, including sound policies and procedures in several of the key sectors; government commitments to investment in agriculture through Kilimo Kwanza, the ASDP, and CAADP; official commitments to participatory planning and priority setting, including at the local level; and a number of strong institutions that support sustainable land management (see Box 2). However, there are also several important gaps and barriers. The Blueprint has already identified a number of key improvements to the enabling environment that are needed to support the SAGCOT strategy. These include:

- Regularization of agricultural taxation, tariffs, and transportation levies to ensure a predictable and fair cost structure for agricultural businesses;
- Development of consistent policies on agricultural trade that do not disadvantage domestic agriculture – including addressing concerns over periodic agricultural export bans; and
- Catalyzing increased private sector investment in agriculture by strategically deploying government and development partner resources.

These issues are equally critical for advancing AGG, and this document endorses the recommendations of the Blueprint related to these topics. However, to achieve AGG at scale, several additional improvements to the supporting environment will be needed. Many of the important issues affecting agriculture, ecosystems, water, and land use in the Southern Corridor are well-known and have been extensively analyzed (see Annex F for a brief synopsis of key studies and prior recommendations). The goal here is not to re-hash these conversations. Rather, the Greenprint focuses on five priorities on which significant progress can be made in just the next few years: 1) agricultural extension; 2) support for local organizations; 3) systematic land and water planning; 4) guidelines for investment in land and agriculture; and 5) a pro-AGG investment generation program.

These priorities reflect the belief that the private sector will be the principal engine for scaling-up AGG. However, they also recognize that different private actors—including small-scale farmers, farmer associations, large-scale farmers, and investors—will require different types of support to adopt AGG at scale (Figure 5-1). See Table 5-1 for a summary of the five priorities and the following narrative for additional details.

Figure 5-1: Impact pathways for achieving Agriculture Green Growth. The figure indicates the ways in which the five key actions identified in this chapter will support the private sector to implement AGG practices, with positive impacts for food production, poverty alleviation, climate change adaptation, and environmental conservation.

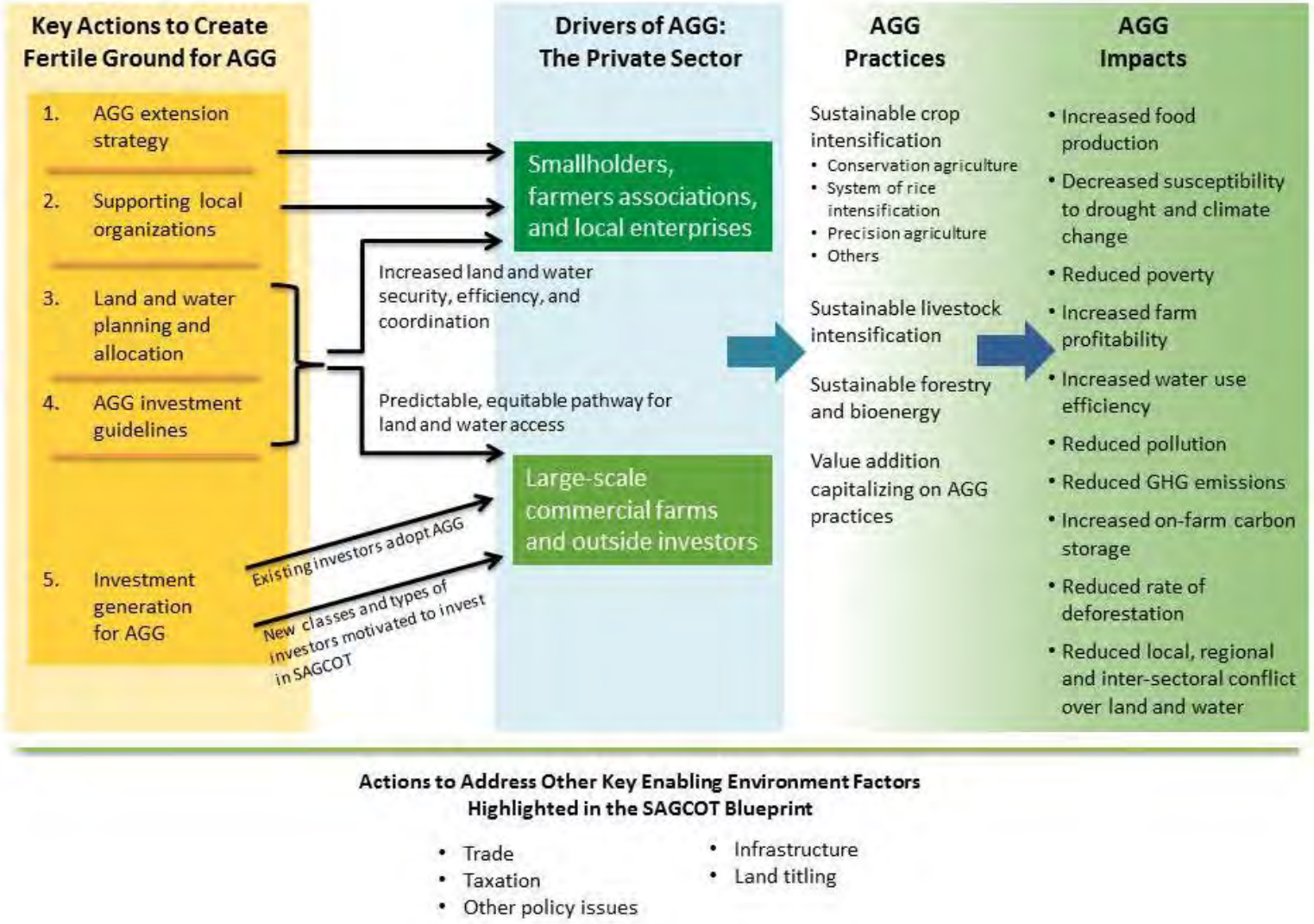


Table 5-1: Five priorities for creating fertile ground for Agriculture Green Growth in the Southern Corridor.

Priority for Creating Fertile Ground	Current Limitation or Need	Key Groups to Engage in Creating Fertile Ground
Agricultural extension	Need for a much larger extension force, greater focus on field-based and participatory methods, and new training in agroecology and natural resource management	• Government extension personnel and decision-makers • Local and international NGOs • National and regional universities and training and resource centers
Support for local organizations	Tanzania has a strong tradition of local organizations and collective action, but these remain a largely untapped resource for catalyzing AGG. New forms of financial and technical support can unleash significant new investment and innovation from the smallholder sector.	• Farmers associations • Local NGOs • Savings and credit groups and other cooperatives • Local political leaders
Systematic land and water planning	Despite official commitments to integrated participatory planning, land and water planning processes are generally sparsely implemented, fragmentary, subject to confusion, and weakly linked to implementation.	• Tanzanian authorities that govern land • District land-use officers and other personnel • Local communities • Water basin authorities • Academic and civil society organizations with technical planning capabilities • Various coordinating entities
Investment guidelines	Lack of clarity on where and on what terms foreign investment is welcome in the Southern Corridor creates unnecessary costs and risks for investors, and uncertainty and risks for communities	• Tanzanian authorities that govern foreign investment and land allocation • International standard-setters • Other interested SAGCOT stakeholders
Investment Generation for AGG	The SAGCOT Investment Generation Programme should convey a single, compelling set of messages to investors that includes the importance and benefits of AGG for SAGCOT investors	• SAGCOT Centre, consultants, and GoT personnel involved in investor outreach • Prospective SAGCOT investors

Agricultural Extension

As noted in the Blueprint, the agriculture sector can benefit tremendously from efforts to increase farmers' access to irrigation, seeds, other inputs, and efficient post-harvest value chains. Knowledge is the glue that binds together these pieces, enabling farmers to make the best use of available resources to boost production, maximize profit, and reduce negative impacts. The Blueprint envisions that large farms and commercial clusters will catalyze a major infusion of new knowledge into the corridor, serving as outward-reaching hubs of research and extension. However, a complementary knowledge strategy is also needed for the large portion of the Corridor's small-scale farmers who will not participate in such hubs. Here, we describe an Agriculture Green Growth extension strategy that will effectively complement the research, knowledge, and extension plans articulated in the Blueprint.

In the vein of the Blueprint, extension is intended to help small-scale farms become or expand as businesses, and to become independent of external aid; for farmers who are not well-positioned for the

market, it should enhance subsistence security.. With this goal in mind, extension services serve a key catalytic role in sustainable agricultural intensification by introducing farmers to new information, new practices, and new skills. This is particularly true in the smallholder sector, where the ideal agricultural inputs may be scarce or unaffordable, but with new knowledge most farmers can substantially increase productivity and profitability with the resources already available to them. In fact, experience from throughout Africa indicates agricultural extension to be among the most cost-effective strategies for alleviating poverty, ensuring food security, and fostering rural economic development.

Unfortunately, along with a broader neglect of agricultural development toward the end of the last century, public sector extension resources were cut dramatically, and the civic and private sectors have stepped in to fill the gap only to a partial degree. As of 2008, Tanzania had approximately 7,800 professional extension workers, compared to the 41,000 that would be recommended to adequately serve the nation's farmers. The GoT has begun to address this situation as part of its commitments to agricultural development, and has begun to hire new agriculture and livestock extension officers, with the aim of eventually establishing a staff of 28,000 extension workers. Some private companies and civil society organizations also employ extension workers. As the GoT expands its extension programs, there is a great opportunity to design and implement these programs to support Agriculture Green Growth. This would entail some changes to the current predominant extension model in the country (Table 5-2).

Table 5-2: Extension for AGG—what is different? The left column identifies key features of AGG cropping, livestock, and resource management systems that distinguish them from past "Green Revolution" approaches. The right column identifies corresponding features of effective extension systems that are likely to support effective, lasting uptake of AGG practices.

Characteristics of AGG Farming Systems	Corresponding Extension Needs
AGG systems may be seen by farmers as radically different from existing/conventional practice, and thus risky	Extension should include ample on-farm demonstrations, as farmers need to "see it to believe it"
	Extension must harness and strengthen knowledge sharing about farming practices based on trust and peer relations
AGG systems are knowledge intensive, based on managing the farm as an agroecosystem	Extension must teach principles of agroecosystem management
Farming systems are adapted to each local context, not a simple "cookbook" prescription	Extension should spend a high proportion of their time in the field, helping farmers use local knowledge to decide how to fine-tune practices to local conditions
AGG is an adaptive approach that responds to changing conditions	Extension should include mechanisms to help farmers experiment for continual improvement and problem-solving
Productive agriculture is predicated on sound natural resource management	Extension curricula should include basics of soil, water, forest, grassland, and/or wetland management
The best AGG solutions sometimes require bringing in new ideas, technologies, or practices from outside the district or even the country	Extension programs should be linked closely to universities and regional and international research and support centres, and extensionists should receive frequent refresher courses in new principles, practices, and technologies

Extension to support AGG practice and improve farm productivity will blend public, private and civic sector personnel and financial resources to tailor delivery systems to the knowledge and organizational needs of specific regions and communities. A tradition of farmer organizations in Tanzania including farmer groups, savings and credit organizations (SACCOs), producer associations and networks provides a sound institutional foundation for building extension that is cost-effective and responsive to the needs and capacities of farmers and their communities. A legacy of decentralization and local engagement in

extension and research planning together with basket funding for national agriculture, food security and poverty alleviation development strategies further strengthens the potential for realizing an efficient, cross-sectoral extension system that draws upon multiple sources of innovation. A number of effective extension models are already in use in the Southern Corridor and other parts of Tanzania, and may be applied and adapted to support AGG. These are highlighted below.

- **Farmer Field Schools (FFS)** use adult learning principles and participatory training methods to facilitate farmer groups in acquiring and applying sound agricultural practices throughout the production cycle (seed to seed). The approach emphasizes experiential learning through field trials and observations. A typical FFS involves a group of 20-25 farmers through which participants sharpen their decision-making capabilities, leadership skills, and capacities for managing complex agroecological systems. There is precedent in Tanzania for linking FFS with local agricultural research committees to systematically evaluate technological alternatives and influence the research agendas of formal research organizations. The FFS methodology is incorporated into many DADPs; presently there are some 6,700 FFSs throughout the country. Significant yield increases are attributed to use of the method: for example, through FFS in Mvomero District, rice production increased by over 100% from an average of 2.5 tons per hectare to 5-6 tons per hectare. Historically, one impediment to FFS implementation has been the need to cover transportation and per diem costs of GoT extension personnel to serve as FFS facilitators. Without such support, service to remote communities is typically lacking and FFS leadership may be sporadic and thus less effective.
- **Farmer-to-farmer extension** trains farmers to train other farmers and thereby develop a cadre of locally based experts, or "paraprofessionals." Farmer trainers are selected by their peers to participate in courses at regional farmer training centers and other locations that qualify them to assist group members in farming techniques. Cross-visits are often used. The approach generates a high multiplier effect. For example, in one region 930 farmers were trained to train other farmers, leading to 69,750 additional farmers acquiring useful knowledge and skills—a multiplier ratio of 1:75. When the approach was introduced through the Kilimanjaro Agricultural Training Center (KATC) in paddy irrigation schemes, paraprofessional farmers trained other farmers in groups of five at a time using their own fields to demonstrate good management practices from seed selection to harvesting. The KATC model led to paddy production increases from 2 to 6 tons per hectare and to the adoption of the model by at least three other agriculture training centers.
- **Extension through outgrower schemes or contract farming** provides training to smallholder farmers as part of the support package than enables outgrowers to produce a consistently high quality and quantity of agricultural raw materials. Under this model, businesses that process and sell crops such as rice, sugar cane and tea secure reliable access to smallholders' produce, while the companies provide producers with inputs, credit, and extension services in addition to a reliable market. The use of participatory extension methods in contract farming in Tanzania has been shown to help build trust between farmers and the company in addition to improving extension efficiency. Trusting relationships, and therefore better contract performance, can be enhanced by training farmers in business and marketing skills as well as production methods. Training may involve professional extension educators as well as well-educated "model" farmers from local villages. In addition, company-based extension personnel sometimes help train other local farmers who may not be company contract farmers *per se*, as a service to the local community or in an effort to expand their raw material supply. An example of AGG extension support for outgrowers is the work of Kilombero Plantations Ltd. (KPL) to train local farmers in System of Rice Intensification (SRI). SRI demonstration farmers benefited from yield and profit increases in the first year, and are expected to pass their skills onto other farmers.
- **Extension led by civil society organizations (CSOs)** frequently combines skills training in agricultural management with farmer organization and empowerment to address the many

dimensions of food and livelihood security. For instance, AMSHA Tanzania builds the capacity of rural farmers to become agricultural entrepreneurs through an innovative agribusiness model that pairs students in agricultural research organizations with local farmers in Kilwa District. AMSHA helps farmers organize into farmers' associations and acquire the technical skills to meet their goals. In 23 villages where AMSHA works, farmers have become measurably more engaged in expanding farming businesses and implementing new technologies, while cooperation among them has grown. CARE is an international CSO that has worked to leverage GoT extension capacity by supporting teams of GoT, CARE, and local community educators to optimize their respective sources of knowledge and expertise for improving the lives of women farmers, their families and communities. The approach values the strategic roles of GoT extension specialists and mobilizes them for field work that government agencies cannot always afford. CARE applies the approach in its conservation agriculture extension program in Morogoro region, among other locations.

- **ICT (Information Communication Technology)** can dramatically multiply the information delivery capacity of extension systems. The use of radio, cell phone, and internet based media can be particularly vital in broadening the role of extension from production agriculture to include services that improve rural livelihoods including enterprise development and marketing. As telecommunication services in rural areas improve, opportunity for demand-driven extension services accelerates and diverse organizations engaged in extension activity are better able to harmonize their efforts. As the SAGCOT initiative takes root and new investment in telecommunications services provides the infrastructure necessary for doing business, ICT-based extension will become increasingly feasible and cost-effective.

An effective AGG extension system will be closely linked to agricultural research to prioritize and use new research on technology development, seeds and varieties, and agronomic practices to increase productivity and resilience for the region's different farming systems and agroecolocial zones. Tanzania's system of zonal Research and Training Institutes (RTIs) coordinated by the Department of Research and Training (DRT), with Sokoine Agricultural University (SAU) at the hub, is well positioned to experiment with AGG practices that are suitable for specific regions. Curricula in AGG technology development and adaptation can be developed for use in education and training of researchers and extension educators at SAU and the respective RTIs. There is precedent for positioning PhD level professionals at RTIs to advance the research that will inform AGG extension in each Institution's respective zone.

With the objectives of SAGCOT and Green Growth in mind, the foregoing approaches may be used as building blocks to develop a strategy for investment in AGG extension throughout the Southern Corridor. The ultimate goal of this system is to support sustainable intensification, increased production, and increased profitability for small-scale farmers. The proposed approaches achieve this by providing farmers with access to knowledge and information that motivates them to observe, try and eventually adopt on a wide scale the types of production and marketing practices that are financially viable, socially beneficial and ecologically sound. In addition to providing instruction in AGG practices and technologies, the extension system will facilitate access to credit, seed and other inputs that are vital to productivity and resource use efficiency.

Extension strategy

A three-pronged strategy will catalyze a vibrant AGG extension initiative. First, existing extension personnel must be motivated and mobilized to deliver effective programs by ensuring that financial resources for travel to the field are adequate, and are dispersed and utilized in a timely way. Second, extensionists and extension paraprofessionals must be systematically trained about context-appropriate AGG practices as well as associated natural resource management and business management skills. This training needs to be coordinated and harmonized across the multiple sectors providing extension services,

including public, private and civic sector personnel in agriculture, livestock, forestry, and related sectors. Third, the AGG extension program should be mobilized in priority clusters with clear targets and thoughtful monitoring designed to extract and apply lessons learned from early experience. This system of "learning by doing" will accelerate the technical and organizational proficiency of the system. Together, these core elements of the AGG extension investment strategy should facilitate broad reach of the extension program followed by widespread adoption of AGG, first in the Clusters and eventually throughout the entire Corridor.

AGG extension targets

As noted earlier, AGG applied on small-scale farms can achieve increases in productivity that would dramatically increase total food production across the Southern Corridor if applied at scale. The extension targets below (Table 5-3) propose a roll-out trajectory for the AGG extension program that would exceed aggregate food production goals, yet remain within the constraints of financing flows for extension that are realistic from the public, private, and civic sectors. As seen in the table, it is anticipated that the reach of the extension program as well as adoption rates would begin relatively slowly and accelerate over time as extension activity becomes more efficient, training materials and systems are developed, and AGG practice becomes more widely demonstrated, profitable and socially acceptable.

Table 5-3: Trajectory for AGG extension and adoption. The table provides estimates of the number of farm households reached by AGG extension, and the number that adopt context-appropriate AGG approaches, in the Southern Corridor through 2030.

Year	Farm Households Reached		Farm Households Adopting	
	Percent	Number	Percent	Number
2015	4%	52,448	2%	26,224
2020	13%	182,159	7%	98,086
2025	35%	524,097	15%	224,613
2030	70%	1,120,155	40%	640,088

AGG extension organization and delivery

AGG extension would be organized around teams whose members coordinate their efforts to provide a strategic set of trainings and participatory methods designed to correspond with the agroecological, socio-economic and institutional conditions in each part of the Corridor. These "AGG Extension Units" will typically include:

- at least one GOT extension professional;
- at least one CSO extension professional and/or at least one private sector extension professional; and
- at least eight paraprofessionals (approximately double the number of professionals).

Each team will be resourced with regular training in AGG approaches and practices, with transportation and communication support, and with finances to conduct seminars and other capacity development activities with farmer organizations and local leaders. AGG extension teams together with these knowledge and mobility resources will comprise an "AGG Extension Unit". The Units will be organized to ensure cross-sectoral expertise in production and marketing of field crops, horticulture and livestock as well as trees and other natural resources. GoT extension workers in each Unit will spend an average of about half their time on AGG activities, depending on the status of AGG knowledge and opportunities in their respective regions. The Units will catalyze partnerships with other GoT extension programs, CSO

programs and commercial producers and will optimize the use of paraprofessional extension workers and of ICT to expand the impact of their effort. Regular participation in AGG training seminars will ensure that knowledge within the Units is up to date and informed by on-going research. The approach will result in progressively increasing numbers of farmers reached per Unit over time as farmers increasingly learn from one another, both formally and informally. Knowledge and information about AGG will also become increasingly widespread and available, supporting additional spontaneous uptake of AGG practices. Table 5-4 projects the number of AGG Extension Units that will be needed to meet the reach and adoption targets presented above.

Table 5-4: Projected roll-out of the AGG extension program. The table indicates the number of AGG Extension Units (as described in the narrative) projected for each five-year period through 2030. The roll-out projections are intended to maximize success in achieving the Greenprint's aggressive scaling-up targets, subject to anticipated budgetary constraints and time required to design and implement quality, evidence-based extension programs.

Year	Number of Extension Units	Households Reached per Unit	Total Farm Households Reached
2015	22	2,384	52,448
2020	49	3,717	182,159
2025	125	4,192	524,097
2030	205	5,464	1,120,155

AGG extension costs

The costs of supporting the AGG Extension Units include salaries and field allowances for professional extension workers, stipends for paraprofessionals, motorcycles and fuel, bicycles, and cell phone allowances to motivate and mobilize the teams. Additional costs include participation by extension workers and by farmers in training seminars, cross visits, and field days, as well as the development of demonstration plots as knowledge resources. Based on this structure, the Green Growth Technical Team prepared itemized budgets for the proposed AGG extension roll-out (see Table 5-5). It is expected that the public, private, and civic sectors will each invest in AGG extension, with differing objectives and priorities. The AGG Extension Unit model is an approach to creating synergies among these multiple investment flows by establishing a common orienting objective, principles, and access to training materials on diverse technologies and best practices to support AGG. As noted in the table, the civic sector, represented primarily through the numerous NGOs and international organizations that operate in the Southern Corridor, will finance the highest proportion of the costs, followed by the GoT and then the private sector through its extension support to smallholders who do not participate directly in contract farming schemes.

Table 5-5: Projected investment needs for AGG extension program. The table estimates the cost of the proposed AGG extension program, including the portion of these costs expected to be borne by the government, civic and private sectors. Costs are in US dollars based on 2012 exchange rates.

Year	Government cost	Civic sector cost	Private sector cost	Total cost
2015	837,147	2,076,124	435,316	3,348,588
2020	3,127,979	7,757,387	1,626,549	12,511,914
2025	8, 673,062	21,509,194	4,509,992	34,692,249
2030	17,776,607	44,085,985	9,243,836	71,106,427
Total (% of total)	**30,414,794 (25%)**	**75,428,690 (62%)**	**15,815,693 (13%)**	**121,659,178 (100%)**

Roles of Local Organizations and Local Leadership

Farmer organizations and supportive CSOs are enabling assets in advancing AGG in the Corridor as highlighted in discussion about the building blocks of an effective extension system. Farmer groups and organizations, especially producer associations, are valuable in organizing for input supplies and post-harvest value addition and sale. Many producer associations have saving and credit cooperative societies (SACCO's) to help their members gain access to micro-finance by negotiating with banks for loans. Other roles that farmer organizations play in fostering agricultural innovation include linking farmers with research and extension institutions to help ensure their programs are relevant to farmer needs and capacities, representing their members in advocacy and policy processes that stand to benefit smallholders, and securing access to resources for capacity development in diverse topics and skill areas. Networking among farmer organizations across different regions and administrative levels is a commonly employed strategy for playing these roles cost-effectively.

Numerous civil society organizations (CSOs) work to strengthen farmer organizations and play other supportive roles in the agricultural economy. These roles include helping to engage local communities in government led policy and planning processes regarding the use of land and resources. In addition to networking, CSOs assume strategic roles in partnership formation with government entities, and increasingly with private sector actors as Tanzania's agriculture becomes more business oriented. Many such networks and partnerships may be looked to for leadership in ensuring that innovation and institutional development for AGG is rooted in local knowledge systems, while simultaneously embracing new opportunities through technical and commercial advances in agriculture.

Examples in the Southern Corridor are highlighted below. By building on the strengths of organizations and initiatives such as these and facilitating expanded investment in their capacities to serve smallholder farmers and their communities SAGCOT stands to harness the powerful assets of social and well as financial capital in its pursuit of sustainable food security throughout the Corridor.

MVIWATA is a national network of farmers' groups formed in 1993 that works to foster communication, information exchange and sharing of experience. The organization serves as a locally based, nationally engaged farmers' organization who aims to ensure representation and advocacy of their members' interests in decision-making at all levels and to provide agronomic and marketing services including access to financial resources. MVIWATA farmers' groups have pioneered the adaptation and adoption of AGG production practices. In the Uluguru Mountain area of Morogoro Region, for example, they have replaced conventional cultivation systems with conservation agriculture including agroforestry and other soil fertility enhancing measures through partnership with CSOs and government agencies. They also have introduced new cash crops and dug water distribution

canals for better management of irrigated agriculture in the region. In more draught-prone areas MVIWATA farmers have adopted rainwater harvesting and a variety of water conservation and soil regeneration measures. MVIWATA documents how farmers in many areas have significantly improved their income levels and paid back small loans by applying these and similar ecologically restorative technologies.

The **Tanzanian Rice Partnership (TARIPA),** one of the first SAGCOT cluster investments, brings together key private sector actors involved in rice, including both large corporations and local smallholder rice associations such as the Association of Kilombero High Quality Rice Growers, with the Government of Tanzania (at national and local levels), development partners (World Bank, USAID, Norad, JICA, FAO) and a range of financial institutions. Through its partnership framework TARIPA works with farmers associations and cooperatives to build small-scale farmer capacity to produce rice for market and increase value addition, while seeking also to scale up core value chain activities to catalyze significant small- and large-scale farmer and agribusiness development in the rice sector and support scaling up of commercial initiatives. TARIPA can play a critical role in making farmer associations aware of the green growth model, helping government to create an enabling environment for green growth, and initiating the replication and expansion of successful models

NAFAKA is a partnership project funded by USAID to improve rice and maize value chains through mechanisms that include improving smallholder access to input supplies through facilitation of small loans to farmers associations. NAFAKA's aim to ensure that the benefits of more productive and profitable grain sectors reach women, youth and other vulnerable populations stimulate the five year initiative to invest in building the capacities of smallholders to participate in new business and growth opportunities through farmers associations and cooperatives. NAFAKA has demonstrated interest in supporting the scaling up of a pilot smallholder training in SRI that was initiated by the Kilombero Rice Plantations Ltd. to rapidly accelerate the adoption of this AGG practice.

PASS (Private Agriculture Sector Support Ltd) is a commercial entity that stimulates investment and growth in commercial farming, and is active in coordinating loans between farmers and Tanzania banks, most of which have financing windows for producer associations' agricultural activities. PASS provides entrepreneurship training through farmers' associations who demonstrate promise in commercialization. With adequate orientation to AGG investment opportunities, PASS could assist farmer organizations develop business plans to finance AGG activity.

Strengthening local leadership to engage farmer associations, SACCOS and their communities in AGG initiatives will require government to create an enabling environment. Roles that government is well suited to assume include fostering awareness about green growth and SAGCOT, developing district investment profiles, systematizing land use planning for better policies and management, enforcing Environmental Impact Assessments for large projects and striving for effective enforcement of existing policies. Government also can champion policies that support building the capacities and influence of CSOs and local leadership in AGG. Through SACGOT, CSOs such as the Tanzania NGO network (TANGO), the Mazingira network and others can share ideas and information about AGG practices as well as strategies and capacities needed for partnering effectively with the private sector. In turn, SAGCOT can encourage CSOs to advise companies about ways to gain social acceptance in rural communities. By serving as a nexus for linking green growth leaders across different sectors and organizations, SAGCOT will strengthen the contributions of each while limiting potential conflict among them.

Land and Water Planning and Allocation

Land allocation, land use planning, and land tenure in Tanzania are complex issues with strong historical, cultural, and political dimensions that have long resisted simple solutions. Yet, Green Growth—indeed, any far-reaching economic growth program—cannot be realized without efforts to plan and allocate land more rationally, more equitably, and more transparently. Water planning and allocation issues have not generated as much public attention as land issues, but are also critical, and likely to become more so as population growth and economic development increase water demand and shift Tanzania into the realm of water-scarce nation.

Several distinct but inter-related land and water issues and needs must be addressed to achieve Green Growth in the Corridor. These include:

1. **Land and water resource planning:** Planning currently takes place at the village, district, regional, and national levels, but the level of capacity to conduct planning at each of these levels is inadequate. For instance, the Land Use Planning Commission has developed a participatory process and set of guidelines for creating village land-use plans (VLUPs), but such plans have been developed for fewer than 1,000 of Tanzania's 11,000 or so villages. Sectoral land use planning (for agriculture, forestry, watersheds, wildlife, et al.) is also conducted through various ministries under multiple statutory authorities, but such plans are rarely integrated or harmonized to a meaningful degree. In the water sector, the National Water Policy of 2002 provides for comprehensive, multi-sectoral water planning and allocation at the basin level, but for various reasons this approach has not yet been fully implemented.
2. **Identification of land for investment:** Currently, there is no single coherent process for identifying lands suitable for agriculture or forestry investment. Additionally, since there is no functioning land bank, investors often need to search for land as part of the project development process.[23] This situation creates additional financial risk for investors. It also places planners in situations where they may face conflicts of interest and communities in planning and negotiation processes that are likely to be coercive.
3. **Community security:** At present, most small-scale land users and communities have relatively little security in their access to land and water. In principle, VLUPs are the basis for defining land tenure regimes that provide appropriate levels of control and security for individuals and communities. In practice, however, only a minority VLUPs have been implemented through the issuance of titles. Furthermore, even where they are in place, planning designations and land titles are frequently not enforced, for both legitimate and illegitimate reasons. Even where VLUPs are in force, there have been instances where plans have been coercively amended when investors expressed interest in lands within a village. Additionally, the President holds the power of compulsory acquisition, under which he may re-designate the use of land to advance the national interest.

The Blueprint recognizes the importance of these issues and recommends new land use planning efforts across multiple scales. This sub-section explains how these recommendations might be implemented in the context of Green Growth to effectively optimize land and water allocation, improve land rights, increase investment opportunity and certainty for investors, and encourage participatory approaches involving all stakeholders.

[23] Although a Land Bank Scheme was established under the Tanzania Investment Act of 1997, this system has not met the intended goal of providing an efficient pipeline for identifying and transferring suitable sites to investors proposing projects in the public interest. For further analysis of the issue, please see "Making Land Investment Work for Tanzania: Scoping Assessment for Multi-stakeholder Dialogue Initiative" (Ngowi and Makwarimba 2012).

Planning process

The Blueprint highlights the importance of coordinating investments and activities at the scale of the SAGCOT clusters. In fact, this scale is equally important for addressing issues of land and resource availability, wildlife conservation, watershed protection, and many others. Yet, there is currently little capacity to plan at this scale. As a result, regional economic development planning (e.g., designation of agricultural investment hubs and identification of suitable sites), environmental planning (e.g., for land, water, and wildlife), sectoral planning (e.g., priorities for investment in agriculture, livestock, and water), and participatory community planning tend to be carried out as separate workstreams that are poorly coordinated. The purpose of establishing new planning capacity at the cluster level is to align these planning processes for mutual benefit. Since SAGCOT clusters are not recognized administratively, such planning could take place by enhancing the capacity, mandate, and information base to plan at the district level.

In broad terms, planning at the cluster or district level within the Southern Corridor should follow a three-step process. First, a systematic assessment of economic, agricultural, and environmental constraints and opportunities should be conducted at the district and/or cluster scale. This exercise would involve integrating a range of existing data (e.g., on land use, agricultural potential, water availability, wildlife habitat and movement, poverty rates, and other themes) along with some new mapping and data collection as needed. At the same time, a consultative process would be conducted with multiple levels of government, local communities, and the private sector to understand plans and priorities of each sector in the district or cluster, economic development opportunities and needs, and priority community concerns. Plans and input already generated through participatory processes such as the CIPs and DADPs would also be integrated. This process would take approximately one year and result in: 1) a robust information base for subsequent village and sectoral planning; 2) identification of locations and issues where coordination across multiple jurisdictions or sectors is critical to achieve Green Growth objectives, such as for watershed management and wildlife corridors; and 3) a preliminary set of top priorities for supporting AGG and attracting beneficial investment, including land and infrastructure needs for developing efficient, vertically integrated agricultural hubs.

The second step is to use this integrated planning foundation as input to developing specific plans in concert with key sets of stakeholders. For instance, participatory village land use planning will be conducted throughout priority districts and clusters. However, rather than conducting VLUPs as isolated exercises, the broader planning foundation will help communities identify and consider opportunities to collaborate with neighboring villages or outside investors to achieve their development aims, conserve important forest and water resources, and minimize the potential for land and resource conflict. The VLUP enables communities to exercise self-determination over their development trajectory, guided both by their own local knowledge and traditional planning practices, and by relevant information from the regional planning foundation, which can be integrated through a variety of participatory methods. Similarly, other planning processes such as the CIPs, water basin planning, planning for conservation areas, and sectoral planning would use the planning foundation to harmonize activities and investments. Although it may theoretically be less efficient to conduct such multiple planning processes, in reality this is the most feasible way to increase harmonization and coordination while giving strong voice to the multitude of stakeholders and respecting Tanzania's existing political and administrative systems.

The third and final step is to "roll up" village and sectoral plans into an integrated district or cluster plan, and to use this plan as a basis developing supportive policies and for monitoring progress over time. At the same time, increased emphasis must be placed on implementing plans through appropriate mechanisms, including land titling processes, development of land banks, allocation of public programmatic funds, and identification of priorities for development partners.

Of course, the three-step process described here must not be a one-off exercise. Rather, it is an iterative process in which the planning foundation (step one) is continually improved and updated; village and sectoral plans are periodically revised; and monitoring leads to the adaptation of strategies to improve results.

Specific needs and first steps

While the process described above is not a simple one, in fact Tanzania already has in place most of the resources and institutions to make it happen. With some support from the SAGCOT Centre, its stakeholders, government leaders, and development partners, it is possible to mainstream a process for coordinated, evidence-based, participatory planning and action in just a few years' time. Specific actions needed to mainstream this process include:

1. **Develop an in-country Green Growth data facility:** Currently, data and spatial information relevant to Green Growth and investment planning is scattered across many ministries, NGOs, and universities. Creating an integrated data facility would enable planners, communities, and leaders at all levels to use the best available information to make decisions. New technologies allow for efficient, user-friendly management and use of such key information.
2. **Increase capacity for district- or cluster-level planning:** District and clusters are often the scale at which it is most important to address key conflicts and synergies. Investment in increased professional capacity to implement the three-part planning process described above will benefit communities, investors, and conservation interests alike.
3. **Establish a functioning land bank:** A centrally administered land bank should be established and professionally maintained to link investors to suitable sites in an efficient, transparent, and equitable manner. In the immediate term, the land bank may be populated with several sites under government ownership that have clear title and status. Basic information about all sites in the land bank should be publicly available on a GoT or SAGCOT website, and can also be incorporated into investor outreach efforts such as the SAGCOT Investment Generation Programme.
4. **Support mainstreaming of VLUP throughout the Corridor:** Village land-use planning is a key mechanism by which land is formally identified and designated for community use and investment. Yet, such planning is relatively costly given that there are thousands of villages in the Corridor. One approach is to set up a VLUP Revolving Fund, which would initially be seeded with some of the resources earmarked for land planning support as an ancillary part of the World Bank's SAGCOT Catalytic Fund investment. Through the VLUP process, lands suitable for investment are identified and placed in a Corridor-wide (or national) investment land bank. As investors decide to acquire and develop available sites from the land bank, they pay a fee in consideration of the pre-acquisition costs already incurred for planning and site identification. This fee is returned to the revolving fund to enable VLPU to be conducted in new areas. In this way, the planning process is de-coupled from the pressured context of site identification for specific investors (who often fund the VLUP processes in hopes of acquiring suitable sites). Communities (in consultation with districts) can identify investment sites in a pro-active manner, while investors can immediately see the full portfolio of available sites and choose a suitable site with no need for time-consuming and uncertain negotiations with communities. (Of course, investors should still expect to negotiate with communities in relation to benefits, profit-sharing, or cooperation.) The first tranche of resources from the VLUP Revolving Fund should be used to conduct planning in clusters of contiguous villages within investment-ripe portions of the priority clusters.
5. **Formalize the rights and procedures associated with VLUPs:** To take full advantage of the planning that is conducted, a streamlined process for implementing spatial plans through the designation of individual, communal, and investment lands should be developed and applied as

the final step in the VLUP process. This process should be designed with the aim of increasing land security for small-scale farmers and communities, while recognizing that formalization does not always equate to increased security. Experiences from implementation of the Strategic Plan for Implementation of the Land Laws (SPILL) will be instructive in this regard. In addition, a formal set of guidelines should be developed for revising VLUPs that are already in place. While it is reasonable that plans will need to be modified over time, it is important that the amendment process not provide an easy vehicle for investors or other powerful interests to supersede the legitimate self-determination of local communities.

6. **Use the VLUP process to resolve reconcilable conflicts:** In the past, issues such as boundary disputes between adjacent villages have inhibited effective planning or implementation of plans. Efforts to identify and address such conflicts should be part of the VLUP process, particularly given that planning will be conducted simultaneously in groups of adjacent villages that may share common interests as well as some areas of conflict.
7. **Establish a strong mandate for inter-sectoral coordination:** A planning process for cluster development will be most effective if sectoral planners and policy makers are willing to consider information, plans, and priorities from other sectors, through the process of information sharing and coordination described above. For instance, if spatial priorities for irrigation development, wetland conservation, and wildlife habitat are considered together, investment in all three areas can be better aligned, while some win-win solutions (such as investment in increased water use efficiency for agriculture) may be identified and deployed. To the extent that such coordination requires shifting how Tanzania's ministries operate, there must be high-level commitment to do so.

This is not an exhaustive list of needs related to land and water planning but rather a set of top priorities to put in place a set of processes that support AGG. Complementary sets of recommendations on land issues are provided in the Blueprint and in the SRSEA.

Investment Guidelines

Across Africa and around the world, there is currently a spirited debate on the merits of foreign investment in land and agriculture. One argument, exemplified by the World Economic Forum's *New Vision for Agriculture*, highlights the important role of international capital and expertise to work hand-in-hand with local communities to jump-start productive agriculture and economic growth. The other viewpoint raises alarm at the recent rash of "land grabs" across Africa that have given foreign investors control over vast land and water resources, often with little concern for—and at great risk to—the environment and the well-being of local communities and the host country.

Despite the polarized nature of this debate, however, most mainstream voices agree that land investment itself in neither inherently good nor bad. Instead, its impact hinges on where and how the investment takes place. There are two key dimensions to attracting investment that is widely beneficial and equitable. The first is to affirmatively identify and seek out desired categories of investors, and to create for them a clear and predictable procedural roadmap for investment. The SAGCOT Centre is already pursuing this tack through its Investment Generation Programme (IGP) and collaboration with the GoT to identify and address key policy and administrative barriers. (Priorities for mainstreaming Green Growth into the SAGCOT IGP are discussed in the next sub-section.) The second dimension is to prevent investment that is unlikely to provide high levels of community and national benefit, sustainability, and equitability. Ideally this is done by guiding such investors toward more desirable forms of investment.

To ensure that investment in SAGCOT is broadly beneficial and equitable, a set of SAGCOT Investment Guidelines should be formulated and applied. These Guidelines serve as an outward-facing statement that

the Southern Corridor is a place that attracts innovators and best-in-class businesses to invest in agriculture and ecosystems. The Guidelines also make clear that SAGCOT will not seek to compete with corrupt regimes that facilitate land grabs, in what may be described as Africa's 'race to the bottom' for investor dollars. Finally, the Guidelines provide a set of Green Growth principles and outcome targets for companies that invest in land and agriculture. In short, Tanzania should not seek to "roll out the red carpet" for any investor that comes calling. Rather it should "roll out a green carpet" that invites and facilitates investment that provides social and environmental as well as economic benefits to the nation and its people.

The Guidelines would encompass investment developed through the SRSEA process, including on issues related to equitable land access and community impacts, such as best practices related to free prior informed consent and resettlement. However, these "do no harm" principles would be supplemented with guidelines about the way in which agriculture, forestry, and other land-based activities are conducted to achieve AGG. These include:

1) Development of a community benefit-sharing plan that includes sharing of future revenue streams, whether through an equity stake or another mechanism;
2) Requirement for commercial agriculture enterprises to support nearby small-scale farmers (in a number proportional to the size of the enterprise) through mechanisms such as outgrower schemes, extension services, or access to reliable input supplies and post-harvest markets;
3) Development of a sustainable intensification plan indicating the types of practices that will be adopted to achieve a high level of water use efficiency, minimize erosion, enhance soil health and fertility, and reduce greenhouse gas emissions; and
4) An environmental assessment of the regional context for the agriculture or forestry operation, including issues of water supply, water pollution, wildlife habitat and movement, deforestation, and indirect effects of any displacement of existing resource users; and
5) A plan for mitigation and/or compensation for impacts identified through the assessment process.

The process of fulfilling the Investment Guidelines is intended to be a constructive one in which investors are educated on potential AGG practices that may simultaneously meet the criteria and enhance the enterprise's bottom line. Already, a number of voluntary systems and management tools have been established to enable agricultural enterprises to conduct self-evaluations to identify ways in which they may increase efficiency, profit, and sustainability.[24] Such tools could be adapted to the SAGCOT context to assist farm managers in decision-making during both the start-up and operation phases.

Ideally, the SAGCOT Investment Guidelines would be fully harmonized with any other regulations or conditions already in place—such as Tanzania's environmental impact review process and conditions attached to the Catalytic Fund—and combined into a single review process. This design would minimize unnecessary regulatory burden for investors while still requiring that they fulfill substantive criteria for responsible investment.

The SAGCOT Investment Guidelines should apply to all proposed investments that exceed a threshold of land area (e.g., 200 hectares) or a corresponding anticipated annual sales figure. As such, the Guidelines may apply to some projects that are not currently required to undergo environmental review. Projects that

[24] Examples of these include the Field-to-Market framework and evaluation tool (http://www.fieldtomarket.org), Unilever's sustainable sourcing strategy and indicators (http://www.unilever.com/sustainable-living/sustainablesourcing/), the Cool Farm Tool (http://www.coolfarmtool.org) and the Environment and Climate Compatible Agriculture (ECCAg) agronomic protocols and assessment system currently being piloted at about a dozen farm plots in the Corridor.

fall beneath the size threshold (including most investments by farmer associations, local Tanzanian businesses, and emergent farmers) will still be strongly encouraged to fulfill the Guidelines.

The Southern Corridor will be known as a place that attracts innovators and best-in-class businesses to invest in agriculture and ecosystems. It will not compete in Africa's race to the bottom.

Along with the initial administration of the SAGCOT Investment Guidelines, a fair and systematic process for monitoring and enforcement of any conditions placed on specific investments must be established and adequately supported in perpetuity.

Investment Generation for AGG

"Investment generation" is the process of pro-actively marketing investment opportunities to prospective investors and partners. This activity is particularly important for SAGCOT, which seeks to attract concentrated volumes of investment in specific sectors and locations. In 2012, the SAGCOT Centre facilitated the process of developing an Investment Generation Programme (IGP), focusing initially on cereals, sugar, livestock, power, and transport as priority sectors. This program is being implemented through investor outreach by representatives of the SAGCOT Centre and GoT together with their consultants.

As noted in Chapter 4, Agriculture Green Growth provides numerous opportunities for investors to enhance profitability, reduce risk, and maintain stable relationships with local communities. Furthermore, through the mechanisms described earlier in Chapter 5, investors will be affirmatively encouraged and supported to adopt AGG. These opportunities should be highlighted in the IGP in a way that fully integrates AGG into the program's core messages. Specific messages could include:

4. Through a combination of coordinated planning, investment guidelines, and AGG support, SAGCOT and its partners are taking concerted action to ensure that water supplies for agriculture remain available and reliable for the indefinite future. Such efforts reduce risk for investors in water dependent crops such as sugarcane and rice.
5. On several of the IGP target sites (particularly existing government farms and ranches), there are opportunities to dramatically increase agricultural productivity through efficient precision and agroecological farming methods.
6. New village and district planning processes and a land bank ensure a predictable, efficient process for acquiring suitable land for agricultural investment and maintaining clear, enforceable rights and obligations going forward.
7. The development of the SAGCOT "brand" as one of sustainable, equitable, transparent development provides a positive association for corporate imaging and branding, and reduces the risk of negative scrutiny or accusations of "land grabbing."

6. An Agriculture Green Growth Approach to Cluster Development

The essence of the SAGCOT concept is cluster-based development that achieves new synergies from co-located investments. This approach requires carefully coordinated spatial planning and investment planning to ensure that each key link in the agricultural value chain is present, and that these links are proximate enough to allow for efficient operations. Agriculture Green Growth adds an additional mandate for coordinated planning by recognizing that the entire value chain depends on a healthy natural resource base. Thus, it will not suffice to pursue isolated strategies that support the specific sustainable intensification, value chain, natural resource, extension, and other investments and strategies identified in Chapter 4, Chapter 5, and in the Blueprint. Instead, these strategies must be aligned at the cluster level through new planning, coordination, and investment facilitation functions.

This chapter illustrates how this synergistic development vision can be achieved by focusing on the three clusters identified in the Blueprint as being particularly ripe for coordinated investment because they already contain some large-scale modern farming, irrigation, and relatively good backbone infrastructure. These "Phase One" clusters include Kilombero, Ihemi, and Mbarali (see Figure 1-1). It is envisioned that similar strategies would be developed for all of the other clusters and, eventually, for all portions of the Corridor where investment and agricultural intensification are appropriate.

Kilombero Cluster

Kilombero Cluster, centrally located in the Corridor, includes one of the most productive and ecologically important wetlands in Tanzania. The Kilombero floodplain supports several large-scale investors who are already engaging smallholders in outgrower schemes for sugar, rice and teak. Backbone road and power infrastructure reaches as far as Ifakara, the major population center, and the TAZARA railway passes close by many of the communities and farms in the Corridor (see Figure 6-1). However, last-mile infrastructure in the Cluster is generally poor, and limits market access for smallholders and new investors, elevates transportation costs, and inhibits the transfer of knowledge and agricultural inputs to farmers.

The Kilombero floodplain was classified as a Ramsar site[25] in 2002, and is managed by the Ministry of Natural Resources and Tourism with support from Belgium Technical Cooperation (BTC). Despite these efforts, the wetland has become progressively more degraded in recent years due to an influx of—and conflicts among—crop producers and grazers. There is little enforcement capacity to address these conflicts, to the detriment of wildlife, fisheries, and human livelihoods. In a similar vein, the expansion of smallholder agriculture (and to a lesser extent commercial farming) has interrupted, and may have now closed off, several key wildlife corridors that once connected the Udzungwa Mountains to the Kilombero floodplain and Selous Game Reserve. Over time, such changes are expected to increase levels of human-wildlife conflict while reducing game populations in the Selous and Udzungwa protected areas.

The Kilombero Valley is generally blessed with good soils suited to a variety of agricultural uses, although drainage and water management is necessary in some places (see Figure 6-1). The Blueprint proposes a variety of new agricultural enterprises in the Cluster, including 14,000 hectares of new and upgraded rice plantations, 20,000 hectares of new sugar plantations, five mixed farms totaling 13,250 hectares, and additional investment in bananas, citrus, and value chain improvements. Given the patterns

[25] Ramsar sites are wetlands of international importance recognized under the Ramsar Convention for their ecological, economic, cultural, scientific, and recreational value.

Figure 6-1 (Kilombero cluster basemap) is available separately for download.

Figure 6-1 (Kilombero cluster basemap) is available separately for download.

of land suitability, much of this investment would likely be concentrated in the rather narrow band of flat, dry land at the toe of the Udzungwa Mountains.

With a high concentration of investment opportunities as well as risks in a relatively small land area, Kilombero may be the most obvious example of why integrated planning is necessary. The three-part planning process outlined in the previous chapter will be an important way to harmonize planning that is already underway in the Ramsar site, CIPs, Udzungwa Mountains, and in the one-third of local villages that have completed VLUPs. One aim of such planning should be to designate blocks of land for commercial investment and different blocks for the maintenance (or restoration) of wildlife corridors (see Figure 6-1). Several NGOs active in the Cluster have a wealth of knowledge on the appropriate design of such corridors. Where appropriate, corridors may be designated as compensation areas to offset environmental impacts of large-scale agricultural development. Given the limited availability of agricultural land of low environmental sensitivity, it will be imperative to integrate smallholders heavily into commercial farming schemes to ensure that they are not displaced to the wetland or forests.

In a similar vein, sustainable intensification of smallholder agriculture will be a critical strategy to improve livelihoods and reduce land conflicts, and the Cluster should be considered a high priority for the early roll-out of the AGG extension program. SRI has already been demonstrated locally and is suitable for rapid scaling-up. Conservation agriculture is also suitable for a range of field crops. Additional sustainable intensification opportunities to be explored further include mechanisms for sustaining wetland fisheries, developing integrated crop-livestock-aquaculture systems, and establishing herder field schools to increase livestock productivity while protecting the wetland. Nevertheless, training alone may not be adequate to address conflict between crop producers and livestock herders: land use zoning and corresponding enforcement may be needed to harmonize land users in an increasingly contested area by designating space for farmers, herders, forests, wildlife, and new investments.

The connection between resource conservation and food production is especially clear in Kilombero Cluster, given that the Udzungwa Mountains furnish freshwater for much of the valley's agriculture, while the meandering waterways of the Kilombero floodplain provide an important fishery resource. Kilombero Plantations, Ltd., has already recognized this reality in its business model, and is working with upstream forest communities to conserve the headwaters that supply water to the farm. Similar systems of payment for ecosystem services should be explored for all major water users in the Cluster. In the long run, such systems may benefit all parties by reducing the risk of water non-availability to commercial farms while compensating upstream communities for any foregone activities. Kilombero Cluster may also be particularly ripe for REDD+ projects, given that agricultural expansion into forests and wetlands is currently significant, but could be curtailed through a mix of sustainable intensification, economic development, and conservation set-asides with appropriate enforcement. REDD+ funds could be disbursed to community members or, more likely, used to invest in local priorities such as feeder roads and social services.

Value-chain development is a high priority for Kilombero Cluster, and is already underway through the CIP and other efforts. Additional investment in local organizations and in small- and medium-sized storage, processing, and marketing facilities is needed to develop a value chain that is prepared to accept the increased crop volumes that the Cluster will soon produce.

Ihemi Cluster

Located in the eastern-most part of the southern highlands, Ihemi Cluster is one of Tanzania's agricultural strongholds and an important region for forest and perennial crop production. Large-scale commercial operations for tea, pulpwood and timber, active in the highlands at the southern edge of the Cluster, are already investigating sustainable production systems that engage smallholders (see Figure 6-2). Both irrigated and rain-fed field crop production is common in the lowlands at the northern end of the Cluster.

Iringa City, the main population center, is located near the center of the Cluster, at the confluence of the main Dar es Salaam-Mbeya road and the road to Dodoma (see Figure 6-2). As in Kilombero Cluster, backbone road and power infrastructure reach the main city but, farther out, infrastructure is poor. Limited access to year-round transportation routes and reliable power sources inhibit economic development and smallholder access to information and improved technologies and inputs.

Along the southeastern edge of the Cluster, the diverse montane forests of the Udzungwa Mountains host critical biodiversity and forest resources. These forests are in high demand from commercial producers for pulpwood and tea plantations, while smallholders rely heavily on the forest for charcoal production. Wildlife also depends on the large tracts of forests as well as on forest reserves across the Iringa highlands to function as corridors between Udzungwa and Ruaha National Parks. In the case of the Ihemi Cluster, livestock production and charcoal production present the greatest threats to maintaining these corridors and halting further forest fragmentation.

Recognizing the Cluster's physical and agroecological diversity, the Blueprint proposes sixteen new mixed commercial farms and four banana farms, together comprising more than 42,000 hectares. It also proposes a range of other investments for storage, processing facilities and irrigation, although the number of storage and processing facilities proposed are roughly half of that proposed for Kilombero in order to allow for increased investment in irrigation, roads and power. The value adding investments are proposed to be concentrated in the highland plateau region, along the major Dar-Mbeya highway, while irrigation and infrastructure investments aim to reach farther out into the Cluster, mainly into the lowland regions to the north and west of the plateau.

The diversity of Ihemi's natural and economic resources likely one reason for the higher incomes seen in this Cluster compared to others. However, this diversity makes coordinating action and investment among actors in the Cluster particularly challenging. Several of the sustainable intensification strategies discussed in Chapter 4 could effectively leverage major new investments in infrastructure and value chain facilities by making more efficient using of new irrigation through precision technologies, reusing crop residues as field cover or livestock fodder, and improving the yields of unaffiliated smallholders, thereby establishing greater and more stable input supplies for local processors. Similarly, sustainable intensification of mixed crop and livestock systems in the highland region could lower producers' input costs and reduce the potential for conflict over resources. The Sao Hill Cattle Ranch, Asas Dairy Farms and other large commercial livestock producers are ideally situated to begin introducing improved dairy and beef breeds, and serve as nuclei for extension on intensive livestock system, inputs, range management and intensive fodder production.

Farmers and businesses in Ihemi Cluster can benefit from the many knowledge, technology, and input supply resources available in Iringa City, particularly if local expertise and knowledge hubs can be established in the hinterlands. For instance, some of the commercial tea plantations already use efficient modern irrigation systems. Concerted efforts to educate producers across the escarpment could lead to increased efficiency of both existing and new irrigation systems, thereby reducing costs and conserving water. In the lowlands, some producers are already experimenting with transitioning some of their land from maize to sunflower to mitigate drought-related crop failure and access oil seed markets. The management systems and processing facilities established for sunflower could be broadened to pilot production and value addition activities with other oilseeds. Rapid roll-out of the agricultural extension program proposed in Chapter 5 would be a cost-effective way of linking actors throughout the Cluster and facilitating rapid exchange of information on AGG practices.

The Iringa Region has been actively involved in participatory forest management (PFM) since the passing of the Forestry Act in 2002. However, villages are only one of many actors in the forests. Tea and pulpwood producers manage large areas of forest land and contract with many villagers to augment their

Figure 6-2 (Ihemi cluster basemap) is available separately for download.

Figure 6-2 (Ihemi cluster basemap) is available separately for download.

raw material supplies. The Sao Hill and Mufindi Paper Mills both have the potential to attract REDD+ financing by pursuing sustainable harvest and afforestation strategies. A bigger challenge is to design PFM arrangements that link communities and commercial producers to bring REDD+ and other carbon finance to help reduce rural poverty and provide finance to catalyze village-level development. One option is to train local communities and develop nurseries to enable community members to plant and maintain high-biodiversity, carbon-rich mixed species plantations on both company and village lands. Conversely, large forestry companies can work with villages under the purview of PFM to commercialize new forest products for additional income streams. Expertise from the public, civic, and private sectors can be combined to develop appropriate extension systems.

More than either of the other priority Clusters, Ihemi requires an integrated strategy that is sensitive to the social and health conditions in the Cluster. Extension services for agriculture, livestock and forestry need to take into account the high prevalence of HIV/AIDS in the region and adjust their programming accordingly. Coordinating extension activities with public health recommendations will be crucial. In specific terms, this may entail working with local extension teams to promote the AGG strategies that help increase household nutritional diversity and require less labor (or provide more flexibility in the timing of labor requirements); conservation agriculture is one example that has been successfully promoted to help households in other regions with a high disease burden. From a risk management perspective, it should be recognized that, although household income in Ihemi Cluster is higher on average, producers may not be willing to incur economic risk related to agricultural activities if they perceive the need to reserve large portions of their income for health costs.

Finally, because of the high biodiversity value of its forests—and the intense pressure from wood fuel demand—Ihemi Cluster should be considered as a high priority for finance and technical assistance related to biogas development. There are additional opportunities to generate energy and fertilizer from recycling agricultural residues on large estates and processing wastes from the existing and planned processing facilities in and around Iringa City.

Mbarali Cluster

Mbarali Cluster is located in the western reaches of the Southern Highlands. The Cluster contains no major cities and has generally poor access to backbone infrastructure, except at the southern end (see Figure 6-3). Ruaha National Park encompasses a large portion of the Cluster, and was recently expanded to ensure suitable year-round water supplies for park wildlife. At the heart of the Cluster are the Usangu Flats, a mosaic of wetlands and agricultural fields whose importance for rice production is comparable to Kilombero Valley. The longstanding presence of irrigation schemes scattered throughout the flats and presence of large farmlands previously owned by the government have helped boost smallholder productivity in the region and connect them to national markets. The lack of backbone infrastructure, population centers and markets is a possible reason for why few large scale commercial producers are located currently in the Cluster. The Ihefu wetlands, a protected portion of the Usangu Flats that is important for biodiversity, as well as Ruaha National Park are managed formally by TANAPA and are home to biodiversity of international importance. Both of these natural areas depend on water from the same rivers that are used to irrigate the Flats.

Water management perhaps the greatest challenge faced by Mbarali Cluster residents and potential investors. There is growing evidence that irrigation inefficiency and oversubscription of river water in the Usangu Flats is causing the periodic dry spells at Mtera dam, which can severely affect the national power supply. While Mbarali currently has more irrigated land than any other cluster, substantial public and private investment is needed to rehabilitate existing systems. Due to the variety of stakeholders dependent on these irrigation systems and existing conflicts over access to water resources, water allocation needs to be addressed through basin level planning processes. Based on evidence about water availability and

flows, economic returns from alternative water uses, and stakeholder participation, such as process may be used to set appropriate water quotas by use (irrigation, livestock, commercial and domestic use, and flows to critical natural areas) and by area. Without a systematic process such as this, water allocation and distribution will continue to occur in an ad-hoc manner that is not equitable, efficient, sustainable or supportive of the SAGCOT development objectives. In addition to basin planning, there is a strong role to be played by water user associations (WUAs) to develop and enforce bylaws on local water use while building the capacity of local water users to become more efficient and productive with the limited water that is available.

Although localized data on soil type and quality are difficult to obtain for Mbarali, available soil maps show large portions of the basin to be poorly suited for agriculture but potentially valuable for grazing and conservation lands (see Figure 6-3). The basin level planning processes and extension units proposed in Chapter 5 could benefit from more detailed soil and water maps, paired with local knowledge of soil and water resources to identify target areas for expanding sustainable intensification in suitable areas. On the other hand, on lands that are marginal for agriculture, the district level planning processes could designate areas for communal grazing as well as village forest reserves generating a variety of products (see Opportunity Analysis #5 in Annex B). Due to the potentially low opportunity cost of foregoing agriculture on marginal lands in the Cluster, villages and farmers may gain geater economic and environmental benefits by taking advantage of REDD+ financing for afforestation or conservation of brush and woodlands. Pressure on water resources by livestock grazers could be mitigated by recuperating some of the old irrigation systems on unsuitable agricultural lands for livestock watering areas. There is also the opportunity to use portions of these lands to establish herder field schools as part of the AGG extension system to disseminate best practices. Establishing some public lands for migrant pastoralists could be an important step for reducing conflicts between crop producers and livestock grazers.

Market access is another challenge in Mbarali. Major non-perishable crops, such as rice and maize, are sold locally and nationally. Warehouse receipt systems have been successful in other areas for facilitating smallholder market access for such staple grains, and could be implemented more widely in Mbarali. Producer associations and local NGOs will also need to play a key role in helping smallholder farmers gain greater market access and negotiating power with higher levels of the value chain.

Since the Cluster itself does not have major population centers, the primary market for most of the Cluster's horticultural crops is Dar es Salaam. Given its distance from this market, Mbarali will not necessarily be able to compete as a low-cost supplier, unless there is further investment in processing facilities to turn horticulture crops into value-added food products. For less-perishable horticultural products, certification or sustainability labels that differentiate such products may draw more profits by accessing new international markets.

Finally, given the increasing demand and escalating conflict related to water availability and use, the Cluster or district planning process for Mbarali should explicitly consider alternative irrigated crops to increase not just the production efficiency of irrigation water, but also the economic efficiency. For instance, high-value crops such as onions and tomatoes typically generate much greater income per unit of applied water, and may offer an attractive pathway for pursing economic development under future water limitations in the Usangu Flats. Moving toward such crops would require investments in storage and processing facilities, as noted above, but could reduce smallholders' risk profile. Given the importance of water availability in farmers' risk profiles, one avenue to explore is the development of micro- and meso-financing mechanisms that preferentially favor farmers practicing sustainable intensification, whose fields are more likely to generate stable income in the face of future water availability conditions.

Figure 6-3 (Mbarali cluster basemap) is available separately for download.

Figure 6-3 (Mbarali cluster basemap) is available separately for download.

7. Financing Agriculture Green Growth

The Green Growth approach involves engaging a wide range of investors, going well beyond typical "business-as-usual" agricultural investment. This chapter describes the different categories of target investors and their anticipated roles in supporting different parts of the AGG strategy. It also proposes a strategy for developing a Green Growth investment pipeline and investment generation facility that links investors that have different sets of objectives with projects in the Corridor that suit their needs. The chapter includes discussion of direct investment as well as mechanisms for financing small and medium enterprises and cooperatives through various types of intermediaries and financial institutions.

Existing Sources of Finance

Many private, public, and donor-supported financing streams are currently supporting agricultural development in the Southern Corridor. Few of these financing sources explicitly favor AGG projects and investments, but most have objectives that are compatible with—and could be advanced by—increased support for AGG. Key financing sources that could be tapped or adapted to strongly support AGG include:

- **Tanzania's Agriculture Sector Development Programme (ASDP):** This program has an overall budget of US $1.78 billion over 8 years, of which about 75% is earmarked for irrigation development. Opportunities exist to more effectively leverage this funding with private co-financing; design water-saving irrigation investments; and increase funding support for AGG agricultural extension as proposed in Chapter 5.
- **The African Development Bank, IFAD, and AGRA:** These international development banks and donors are providing approximately US $155 million for marketing infrastructure, value addition, and rural finance support program. All of these types of investments are critical to support AGG. Rural finance support, in particular, could be structured to favor investments in sustainable intensification based on its anticipated profitability and lower risk profile compared to high-input approaches that do not incorporate water and soil conservation practices.
- **AGRA/Standard Bank and AGRA/NMB:** AGRA has established a US $25 million loan guarantee facility to support Standard Bank and the National Microfinance Bank with the goal of supporting established and commercially viable agriculture businesses that incorporate smallholder farmers.
- **Domestic lending to agriculture:** In 2008, domestic lending to agriculture in Tanzania was TzSh 540 billion (approximately US $360 million). However, less than 8% of this finance flow (US $29 million) financed primary agricultural production.
- **Microfinance:** NMB, AGRA, and the Financial Sector Deepening Trust (FSDT) are providing US $6.3 million for an agricultural loan program for outgrower input finance.
- **Private Agricultural Sector Support (PASS):** PASS is a facility to support small businesses with technical assistance (e.g. business plan development, feasibility studies, and organization of farmer groups) and financial services (e.g., loan guarantees) focused on agricultural production and processing businesses.

New Sources of Finance for AGG

Tanzania, and Africa in general, are experiencing unprecedented growth in private agricultural, forestry and related investment. Yet only a few investors have made an explicit business commitment to advancing rural development, poverty reduction and protection of ecosystem services and biodiversity as

well as private profits. SAGCOT, through its Agriculture Green Growth strategy, has the motivation and potential to attract these investors, particularly with a proactive effort to market its enabling environment for such innovative investments. Four sets of investors are of particular interest: sustainable agriculture investment funds; climate change mitigation funds; debt finance with 'green' screening criteria; and companies investing in agriculture that incorporate environmental and social values in their business models.

Sustainable agriculture investment funds

A growing number of social investors and impact investors are setting up funds, usually linking private finance with financing from NGO's or philanthropic organizations. Some promising examples for Tanzania include:

- **Inari:** This innovative initiative was developed by The Munden Project for investment in sustainable land management at scale in the developing world. The initiative is designed to drive financing to sustainable producers, in a way that improves their livelihoods and protects the environment. It seeks to accomplish this by aggregating payments from those producers into investment grade securities that offer a compelling risk-reward profile.[26]
- **African Agricultural Capital Fund:** In 2011, USAID established a new fund to support agriculture-based businesses in Africa. Pearl Capital Partners (PCP), a specialized African agricultural investment fund manager based in Kampala, Uganda, will invest the AACF's US $25 million in at least 20 agriculture-related businesses in East Africa. To attract investors, USAID's Development Credit Authority is guaranteeing 50% of an US $8 million commercial loan from J.P. Morgan's Social Finance Unit to AACF. The fund is also supported by US $17 million in equity investment from the Bill & Melinda Gates Foundation, the Gatsby Charitable Foundation, and the Rockefeller Foundation. The fund will also have access to US $1.5 million in USAID-funded business development services, primarily funded under the Feed the Future initiative, to improve investee companies' operations, competitiveness, and access to markets. PCP's model focuses on building the skills of local management teams rather than infusing management expertise from abroad. The fund's co-investors are all members of the Global Impact Investing Network (GIIN) Investors Council. USAID, J.P. Morgan, and the Rockefeller Foundation are anchor funders of the GIIN, which is a nonprofit organization dedicated to increasing the scale and effectiveness of impact investments.
- **EcoEnterprises Fund:** The EcoEnterprises Fund, operating since 2000, is a pioneer in impact investing that provides capital to small and medium-sized businesses that have important positive impacts on ecosystems. The EcoEnterprises Fund II will soon be launched. The current focus is Latin America, but African opportunities will also be explored.[27]
- **Sustainable Landscapes Investment Fund:** Through its multi-sector Platform for Biodiversity, Economy and Ecosystems, The Netherlands is in the process of developing a Sustainable Landscapes Fund to mobilize private sector investment, supported by the philanthropic and public sector sectors. SAGCOT can actively market investment ideas with this group, based on the several ready-to-go landscape investment opportunities identified in this report and by SAGCOT stakeholders.
- **Rabo Sustainable Agriculture Guarantee Fund:** The world's largest agricultural bank, Rabobank, recently established a fund that uses screening criteria to ensure the sustainability of its agriculture investments.

[26] For more information, see http://www.fao.org/docrep/016/ap076e/ap076e.pdf.
[27] For more information, see http://ecoenterprisesfund.com

- **International Finance Corporation:** The IFC now has in place a number of different windows for private sector loans that have strong environmental and social co-benefits. These include expansion of eco-certified agricultural commodity production, investments that will improve water management in agriculture, sustainable forestry. IFC also has advisory services set up that could work with SAGCOT on pre-investment planning.
- **Root Capital:** This nonprofit finance organization provides credit to small and growing businesses in rural areas that require more than a microloan but are not yet qualified to receive conventional commercial credit. Its short term loans allow businesses to buy raw goods from farmers, thereby supporting aggregation and marketing to connect small-scale farmers to markets. Root Capital also makes some longer-term loans to enable businesses to build infrastructure. Root Capital has funded several Tanzanian businesses, including an Arusha-based organization calle Nyirefami, which processes and exports millet, wheat, sorghum and bananas. Models such as this could be scaled up to build capacity and create access to credit to grow small rural businesses in the Clusters.

Climate mitigation investment funds

Other private sector funds have been established to support terrestrial carbon sequestration and avoided deforestation.

- **Livelihoods Fund:** The Livelihoods Fund is a carbon investment fund that has three criteria for investments: social impact, environmental impact, and carbon sequestration**.** The Fund mobilizes companies, financial institutions, and large foundations, which invest their money in a 30-50 million euro mutual fund. The Fund then uses this money to finance programs in the field. In return, investors receive carbon credits to offset their own greenhouse gas emissions or sell the credits to others. All Fund programs are registered under existing CDM or VCS carbon accounting methodologies. The Fund aims at the best quality social and environmental standards such as the Gold Standard or CCBA. A rigorous process is followed to measure the carbon sequestration and register the projects through the United Nations Framework Convention on Climate Change. Four companies have invested so far: Danone, Schneider Electric, CDC Climat and Credit Agricole.[28]
- **Company-based Voluntary Carbon Offset Projects:** A number of private companies are seeking to bolster their credentials on sustainability by investing in land-based carbon projects to offset their greenhouse gas emissions. To enable them to do so, several intermediary carbon project developers have been established to implement sustainable land-based projects and sell the resulting carbon credits. For example WildlifeWorks is a private climate fund investing in voluntary and CDM carbon credits, which are then sold to companies marketing consumer products such as clothing. The group's first certified REDD+ project investment was recently initiated in Kasigau, Kenya.[29]
- **Terra Global Capital:** Terra Global has an investment fund that seeks assets for land use-related climate offset investments.[30]

Financial institutions with sustainability screening criteria

Increasingly, international lending institutions are incorporating sustainability screening criteria into their lending processes. This means that projects seeking financing are more likely to be able to obtain it—or to receive better financing terms—if they fulfill criteria related to social and environmental performance. One example of such criteria is the Equator Principles, which international banks voluntary adopt as a

[28] For more information, see http://www.livelihoods.eu/livelihoods-funds.html.
[29] For more information, see http://www.wildlifeworks.co.uk/.
[30] For more information, see http://www.terraglobalcapital.com/.

stated commitment to avoid investing in enterprises involved in tropical deforestation. As of 2012, 77 financial institutions in 32 countries have adopted the Equator Principles, collectively representing more than 70% of international debt finance in emerging markets.

Private investment incorporating environmental and social factors into business models

There is particular value to SAGCOT in attracting international companies that have already developed business models that incorporate environmental and social values. These not only may find it easy and appealing to align with the AGG strategy, but also bring valuable technical and business expertise that can enhance capacities in the region. Having companies that have their own branding related to sustainability can enhance the reputation of the region as a whole and attract other such companies.

While numerous such companies exist, it will require deliberate effort on the part of the SAGCOT Centre, GoT, and other stakeholders to encourage them to invest in the Corridor. As part of the Investment Generation Programme, the SAGCOT Centre can undertake an identification and screening process to select candidate companies and proactively approach them to explore investment opportunities in the Corridor. One starting point would be to approach the major international commodity roundtables (for sugar, soy, beef, and biofuels) to identify industry leaders on sustainable production.[31]

[31] These roundtables include the Better Sugarcane Initiative (Bonsucro; www.bettersugar.org); the Round Table on Responsible Soy (www.responsiblesoy.org); the Global Roundtable for Sustainable Beef (www.sustainablelivestock.org); and the Roundtable on Sustainable Biofuels (http://rsb.epfl.ch).

8. Next Steps

The next two years will be a pivotal period to jump-start and build momentum for the AGG approach in the Southern Corridor. This chapter identifies specific actions that the SAGCOT Centre and partners can take to establish this momentum and lay the foundation for scaling up AGG investments in the region. These actions fall into five categories:

1) Engaging key national and local stakeholders;
2) Strengthening and demonstrating integrated planning in selected Clusters;
3) Catalyzing investment in selected ready-to-go projects;
4) Marketing AGG investment opportunities to domestic and foreign investors; and
5) Strengthening the analytical and knowledge base for AGG in the Southern Corridor.

Engage Key National and Local Stakeholders

The SAGCOT Centre and partners have a unique opportunity to create a culture of AGG knowledge and practice that engages key actors and establishes key organizations that can catalyze widespread uptake. To do so will require a concerted outreach program over the 12-18 months that does four things:

- Shares tangible and compelling messages about AGG and its potential benefits with all relevant stakeholders;
- Invites stakeholders to help refine the AGG strategy based on their own knowledge and experience;
- Recruits a cadre of local, national, and international champions of the AGG approach that can "fan out" to disseminate key messages to their own colleagues and networks; and
- Develops a strategy for high-level "headline" events and messages that highlight AGG as an innovative component of the SAGCOT strategy and of Tanzania's bid to create the world's first sustainable agricultural development corridor.

To implement this outreach program, the SAGCOT Centre could produce a set of materials targeted to farmers and communities, businesses, international investors, and government officials at all levels, that explains the rationale for AGG and illustrates key strategies and investment options. While AGG practices and benefits are not especially difficult to understand, they may be new to many target audiences. Accordingly, the outreach program should use visually oriented messages and multiple outreach media, and include training and briefing for journalists to develop engaging stories around innovative AGG leaders, businesses, and impacts. The Agriculture Green Growth Portal (www.AgricultureGreenGrowth.com) can serve as a home for the full set of outreach materials, while providing additional practical guidance and regular updates for those who are ready to learn more and implement AGG. Finally, a series of AGG Leaders Workshops, following in the vein of the first workshop in May 2012, should be convened to bring together stakeholders to develop more detailed AGG strategies for Clusters and investment target areas. One such workshop would convene high-level government agencies to discuss inter-ministerial coordination.

Strengthen and Demonstrate Integrated Planning

Implementation of the AGG vision should begin immediately in priority Clusters.Until practical implementation of the approach is under way, AGG risks being viewed as a concept only and therefore not worthy of serious consideration by investors. Furthermore, there is a certain amount of "path

dependency" in any economic development program: if AGG planning processes and investments are espoused from the outset, it will become easier to leverage additional AGG investment going forward.

To begin, the SAGCOT Centre should work with its key partners to select one of the priority Clusters (Ihemi, Mbarali, or Kilombero) for immediate implementation of the integrated AGG Cluster planning process described in Chapter 5. This process would get underway by early 2013, and likely result in a fully functioning land bank within a year after that. By 2014, the planning process can be expanded to additional clusters, adapting it as appropriate based on experience from the first cluster. Planning work in the first cluster could be co-financed through bilateral funding from a donor associated with the Green Reference Group, but also strongly leverage existing planning capacity.

To support the integrated planning process, it will be critical to set up a SAGCOT data and analysis facility for maintaining and using information on agriculture, environment, poverty, and economic development—and from ensuring that such important data do not remain siloed in different institutions and sectors. This facility would include a strong component of spatial data, with technical expertise to run geographic information systems (GIS). Additionally, a cadre of professional planning facilitators will be needed to run district and village planning processes. There are already many such professionals working throughout the Corridor, but additional training and backstopping in integrated planning for AGG will help ensure a rational and participatory set of planning processes. As a first step, integrated planning in each clusters could begin with a cluster-focused AGG workshop, drawing approximately 50 people from critical stakeholder groups in the cluster. The cluster analysis maps created for this Greenprint may be used and adapted to help facilitate dialogue and decision-making at such workshops.

Catalyze Investment in Ready-to-Go Projects

One important way to kick-start interest in AGG is to launch a few successful projects that can serve as tangible examples or demonstration sites for future investors. To do so, the SAGCOT Centre and its partners should identify 3-4 ready-to-go AGG projects in the Corridor that can increase food production, farmer income and/or investor profitability in a short time period. These 'quick wins' could potentially be supported by the Catalytic Fund, once that becomes operational, but could also be of interest to private or civic sector investors. Several candidate AGG projects are highlighted throughout the Greenprint, including investment in smallholder conservation agriculture or system of rice intensification; co-financing to help commercial farms invest in precision agriculture machinery and systems; intensification of livestock production and processing on one of the Corridor's NARCO ranches; and investment in community forestry enterprises yield multiple revenue streams. Catalytic Fund resources could also assist in opening new marketing channels explicitly linked to AGG, such as expansion of eco-certification for tea, coffee, fruits and vegetables; and development of agro-ecotourism business in areas where agricultural production abuts traditional tourist attractions.

Simultaneously, SAGCOT Center and partners should work with the GoT and development partners to design and catalyze investment in the AGG Extension Program. As a first step, the SAGCOT Center could bring together extension experts and designers from government, civil society, and the private sector to design a prototype "AGG Extension Unit" along the lines described in Chapter 5. This would be followed by more detailed scoping of training needs and existing capacities and how these vary in different parts of the priority clusters. The resulting AGG Extension Unit model should then be tested in 10-20 communities beginning by the second half of 2013. During this period, the SAGCOT partners will also work to secure commitments from key public, private and civic sector actors to coordinate the development of AGG training curricula; mobilize personnel to deliver it; and field visits to companies and farming areas practicing AGG; and develop a comprehensive financing strategy for scaling up the AGG Extension Program. By 2015, with additional earmarked resources and experience from the pilot phase, the program will be ready to go to scale.

A final important early step for the SAGCOT Centre is to link with other Tanzanian institutions, such as the Tanzania Investment Bank, to set up a locally led AGG Finance Pipeline, as outlined in Opportunity Analysis #8. This activity should be aligned with the SAGCOT Investment Programme, which is also working to identify ripe investment opportunities and market these to investors.

Market AGG Opportunities to Domestic and Foreign Investors

To bring in socially and environmentally responsible investors who will be interested in investments that follow the Greenprint concept, SAGCOT will need an aggressive strategy to identify, inform and attract them to the region. These efforts should be incorporated into the Investment Generation Programme already underway. Four short-term activities are recommended, to be woven into the broader IGP as appropriate:

1. Engage business communications professionals to develop materials for marketing the AGG strategy and specific investment opportunities to potential business and financial investors. These materials should specify support available for AGG, relevant aspects of the policy environment, specific sites and opportunities available for AGG development, and the expected standards for AGG (which, in fact, would be the same standards expected of all SAGCOT investment).
2. Program a "roadshow" on AGG for representatives of the GoT, SAGCOT Centre and/or Tanzanian business leaders in the Corridor to meet with impact investors, sustainable investment funds, and agricultural and forestry companies in Europe, North America, Brazil and elsewhere, whom research has identified to be especially promising.
3. Convene a workshop on financing AGG investments for Tanzania-based banks, investment groups and businesses to showcase opportunities to scale up successful businesses in the Corridor. Review the recently-adopted FAO voluntary guidelines on agriculture investment and recommend actions needed for Tanzania and SAGCOT to be fully compliant, and advertise that compliance with potential investors.
4. Initiate a process for SAGCOT to develop a pipeline of investable smallholder-based projects and businesses in collaboration with impact and other private investors to build the institutional capacity over 2-3 years for villages and farmer organizations to be "investment-ready."

Strengthen the Analytical and Knowledge Base for AGG

To fully realize the potential of AGG in the Southern Corridor, agricultural production systems, natural resource management systems and market development will require a strong knowledge and evidence base. Its development requires bringing together existing information in a usable form, answering strategic questions about farm and landscape management, and extracting lessons from experience throughout the Corridor to continually improve options for increasing the productivity and profitability of agriculture and forestry, with benefits for communities, the environment and the climate. Over the next six to 24 months, work should be commissioned to begin developing this knowledge through the types of activities identified below.

- Prepare more detailed Opportunity Analyses for the AGG opportunities presented in this framework document, and develop additional analyses on topics such as sustainable irrigation systems.
- Explore strategies and prospects for developing eco-standards for rice in the region; a prospective timeline for this activity was drafted at the AGG Leaders Workshop in May 2012.

- Explore the potential demand and development options for eco-friendly and climate-friendly product labeling for SAGCOT AGG producers and businesses.
- Provide design input for an AGG Finance Pipeline with emphasis on the investment portfolio and due diligence work of the Tanzania Investment Bank.
- Prepare more detailed analysis of the types of hydrologic and watershed management that can ensure adequate water availability for wildlife habitat, tourism and domestic uses, as well as sustain water flows for irrigation.
- Develop more detailed analytical methods for spatially targeting AGG investments where they are most needed and stand to deliver the greatest economic and ecological benefits.
- Develop systems to track change in the Corridor across multiple landscape dimensions (sustainable productivity, ecological integrity, livelihood security, institutional capacity).
- Develop an evaluation framework and methodology for the AGG strategy and implementation plan that can be used to sustain multi-stakeholder engagement in the Corridor and individual Clusters.
- Mobilize research in the region to support AGG, tapping the considerable agricultural, environmental and development research underway in the country by universities and research institutes that can provide technical input into design of investments and address knowledge gaps and challenges for implementation. Two immediate steps should involve: 1) organizing a workshop with Tanzanian researchers to inventory relevant research already produced and underway, and identify priority areas for supporting on-the-ground investments or analyzing ways to strengthen investment plans; and 2) facilitating a meeting of representatives of the Consultative Group on International Agricultural Research (CGIAR) centers in Tanzania and East Africa to set up "sentinel site" landscapes within selected Clusters to conduct monitoring and research that directly supports SAGCOT farmers, agribusiness and land managers.

9. Agriculture Green Growth Vision of Success

Looking ahead twenty years, we can envision three possible—and quite different—development trajectories for the Southern Corridor. "Business as usual" is a pathway of unfulfilled potential, in which rural poverty and environmental degradation continue in a vicious cycle, despite some gains resulting from current and planned investments in agriculture and rural development. A second pathway is that of agricultural intensification with prevailing practices (AIPP). Under this approach, major external investment is leveraged to expand input intensive agriculture to dramatically increase food production, with projected benefits for many smallholders, farm workers, and value chain actors. But, without specific strategies for addressing climate change, land and water optimization, and other elements of sustainable intensification, environmental impacts are likely to be severe, and could undermine the region's productive capacity. Meanwhile, benefits will bypass the majority of small-scale farmers.

The Greenprint has proposed a third pathway: that of broad-reaching Agriculture Green Growth. A strong cadre of leaders committed to this vision already exists throughout the private, public, civic, and grassroots sectors in Tanzania. In this chapter, we quantify the benefits could be realized if these people were fully supported—and if additional participants were encouraged and incentivized to join a broad-reaching effort to implement sustainable, agriculture-led development. The Green Growth Technical Team developed scenario models to estimate impacts on crop production, greenhouse gas emissions, water use, and deforestation under AGG as proposed in the Greenprint, compared to AIPP. These projections use data from the Blueprint, information on existing conditions in the Corridor, evidence on the impacts of AGG practices in sub-Saharan Africa and elsewhere, and Greenprint plans to estimate impacts over the next twenty years. (For additional information on how the projections were developed, please see Annex D.) These projections indicate that AGG, if implemented in the way proposed in the Greenprint, will provide widespread benefits for food security, economic development, environmental sustainability, and ecosystem conservation.

Impacts on Food Production and Livelihoods

The projections examine food production for three crop categories: sugar, rice, and field crops (consisting of oilseeds, legumes, and grains other than rice). In total across the entire Corridor, the Greenprint strategy is projected to increase food production by 25% compared to the AIPP scenario, by the year 2030. These gains are attributed to the increased emphasis placed on increasing the productivity of smallholders that are not involved in outgrower or block farming schemes ("unaffiliated smallholders") (see Table 9-1 and Figure 9-1). Since this group comprises the majority of farmers, farmland, and crop production in the Corridor, productivity gains among unaffiliated smallholders result in very large gains in aggregate food production. Such gains will be achieved through sustainable intensification strategies (see Chapter 4) supported by programs for extension and local organization support (see Chapter 5) and by complementary Blueprint strategies for increasing farmer access to reliable, high-quality inputs and post-harvest markets. By the year 2030, unaffiliated smallholders will produce 70% more rice and field crops under the Greenprint strategy than in the AIPP scenario. This represents a gain of more than 2.2 million tons per year worth approximately US $600 million (936 billion TzSh) at recent market prices.

Compared to agricultural intensification with prevailing practices, AGG will generate the greatest gains for field crops, for which practices such as conservation agriculture and water harvesting will greatly increase per-hectare yields for smallholder farmers. In the event of increased droughts or other unfavorable conditions associated with climate change, production under all scenarios would likely be lower, but the relative productivity gains associated with AGG could be even greater because of the increased resilience achieved by farmers. Yield gains will also be achieved for smallholder rice, based on up-scaling of SRI. AGG is not expected to significantly increase per-hectare yields for rice or sugarcane

for commercial farms or satellite smallholders compared to AIPP. However, precision agriculture practices used on these crops under the AGG strategy will provide at least comparable yields while increasing input use efficiency. By optimizing use of water, fertilizer, pesticides, and energy, commercial farms and satellite smallholders will be able to reduce costs and boost profitability. They will also reduce their impact on the environment and help to sustain productivity well into the future through stewardship of water and soil resource (see Table 9-2).

By adding a focal emphasis on improving the productivity of unaffiliated smallholders, the Greenprint will help the SAGCOT Initiative to deliver more widespread and equitably distributed benefits. Increases in the production of staple grains (+58% for field crops and +10% for rice compared to the AIPP scenario) will also make important contributions to food security at the national and regional levels (Figure 9-1). Since most of these gains will be based on agroecological farming systems, farmers will also possess the knowledge and technology to adapt their cropping practices over time in response to climatic, environmental, or market changes. Complementary strategies proposed in the Blueprint, such as improving access to high-quality seeds, other inputs, and weather insurance, will also be critical for improving farmers' resilience.

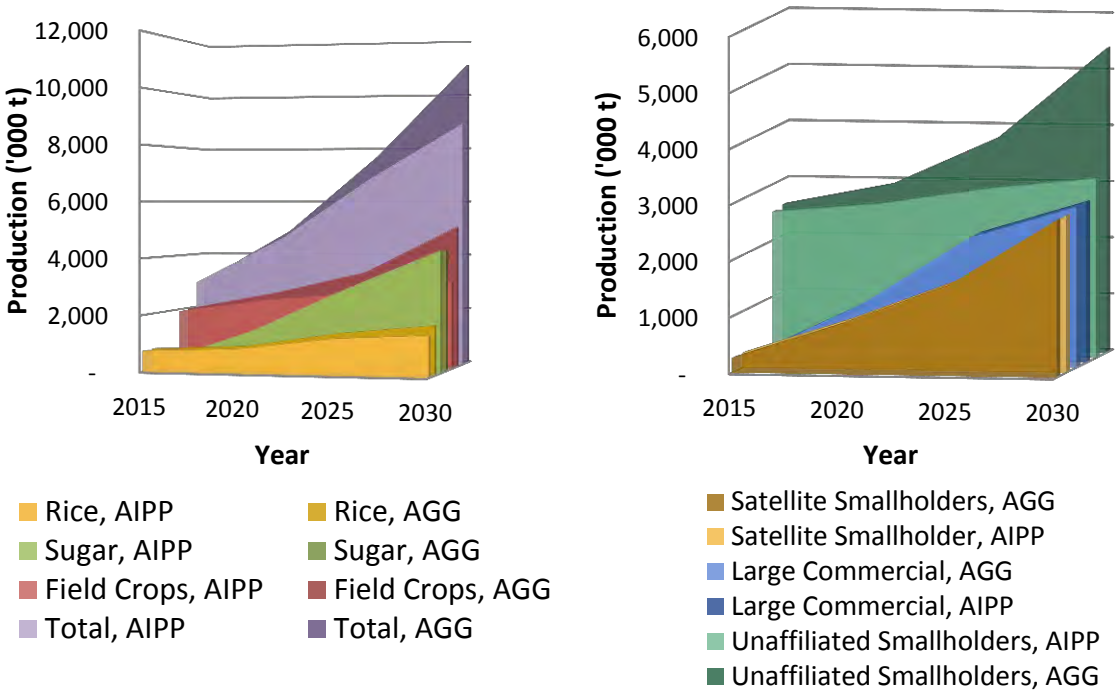
As more smallholders generate crop surpluses, they will partially or fully move out of subsistence farming. Farmers associations and local enterprises will play an important role in supporting value addition and marketing to enable farmers to benefit from these increases in productivity. As per-area yields increase, pressure on forests from the expansion of subsistence agriculture will decline: more farm households will be able to feed their families on existing plots, opportunities for farm profitability and value addition will grow, some subsistence farmers will move into other lines of work, and the relative economic appeal of opening up new subsistence plots on marginal land will diminish.

Table 9-1: Projected crop production. The table provides total food production estimates for the AGG and AIPP scenarios. Table (a) provides estimates for total production of sugar, rice, and field crops, in five-year increments through 2030. Table (b) allocates production according to producer group. In this table, "Satellite Smallholders" refer to small-scale farmers affiliated with commercial farm hubs through outgrower schemes, block farming, or contract farming arrangements. "Unaffiliated Smallholders" refer to small-scale farmers who do not have a relationship with a commercial hub (but may be involved in a local farmer association, marketing cooperative, or similar entity). Production estimates are in thousands of metric tons.

(a)	AIPP Estimates ('000 t)				AGG Estimates ('000 t)			
Crop	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Sugar (cane)	240	1,380	2,904	4,297	241	1,308	2,904	4,297
Rice	744	855	1,273	1,444	747	891	1,396	1,717
Field Crops	1,935	2,394	2,698	3,114	1,974	2,609	3,398	5,075
Total	**2,919**	**4,629**	**6,874**	**8,855**	**2,961**	**4,881**	**7,698**	**11,089**

(b)	AIPP Estimates ('000 t)				AGG Estimates ('000 t)			
Producer Group	**2015**	**2020**	**2025**	**2030**	**2015**	**2020**	**2025**	**2030**
Large Commercial	145	1,056	2,277	2,864	145	1,056	2,277	2,864
Satellite Smallholder	264	890	1,614	2,803	264	890	1,614	2,803
Unaffiliated Smallholders	2,511	2,683	2,983	3,188	2,552	2,935	3,807	5,422
Total	**2,919**	**4,629**	**6,874**	**8,855**	**2,961**	**4,881**	**7,698**	**11,089**

Figure 9-1: Projected crop production. The figures compare changes in annual crop production in 2015, 2020, 2025, and 2030 for AGG versus the AIPP strategy.



By focusing strongly on improving productivity for unaffiliated smallholders, the Greenprint strategy will greatly expand the reach of the poverty alleviation benefits provided by the SAGCOT initiative. By 2030, at least 40% of smallholder households (about 640,000 households) are expected to adopt AGG practices on their individual plots, while additional rural residents will benefit from association with commercial hub farms. Based on currently achievable yields—even under low-input conditions—the large majority of households that adopt AGG practices are expected to become food secure, and most will have marketable surpluses. The development of fully integrated value chains will not only benefit farmers, but also create significant employment opportunities, while absorbing surplus labor that becomes available through increases in farming efficiency. In sum, the investments described in this Greenprint and in the Blueprint will benefit in excess of one million households containing a total of more than five million persons.

Impacts on Environment and Natural Resources

In addition to increasing food production, AGG will reduce the negative environmental impacts of agriculture in the Southern Corridor. By doing so, the Greenprint strategy will reduce conflict among communities and sectors (e.g., for limited land and water resources) while increasing the total economic benefits realized from the region's land and water resources.

The impact projections estimate the potential effects of the AGG strategy (relative to the AIPP scenario) on three key factors: 1) deforestation, 2) net greenhouse gas emissions, and 3) water use. The model considers only the impacts of agricultural practices on these factors. However, other components of the AGG strategy (such as community forestry and energy efficiency) could have additional benefits for conserving forests and reducing greenhouse gas emissions.

Without AGG, continued low productivity on unaffiliated smallholder farms, combined with population growth, will push farming households to convert more land for subsistence agriculture. In the AIPP scenario, agricultural land use in the Corridor will expand by 25% in the next twenty years, resulting in deforestation and conversion of more than 500,000 hectares of Miombo woodland, highland forests and savannas. Under AGG, some conversion for subsistence agriculture will still occur—particularly in the first ten years—but the progressive roll-out of extension programs and other support for smallholder sustainable intensification will result in only 11% total agricultural land expansion over the 20-year period, preventing 300,000 hectares of land from being deforested or converted (Figure 9-2). In addition, as marginal farmlands become uneconomic relative to newly productive smallholder farms, AGG would likely result in the abandonment of at least 18,000 hectares of existing marginal farmland, which could potentially be available for ecological restoration. Under both scenarios, the new commercial farms identified in the Blueprint are assumed to occupy primarily existing agricultural lands.

Over a 20-year period, the AGG strategy will result in a net reduction of greenhouse gas (GHG) emissions totaling nearly 30 million tons CO_2-equivalent, worth almost US $300 million at recent carbon prices of $10 per ton of CO_2-equivalent (Table 9-2 and Figure 9-3). More than 90% of these reductions are associated with avoided deforestation, while the remainder results from increased soil carbon and avoided emissions from agricultural practices. Avoided GHG associated with sustainable intensification of rice and livestock production were not included in the model, due to data uncertainties, but could significantly increase these estimates. The anticipated emissions reductions from AGG could open the door to significant new financing from international carbon markets and REDD+ financing mechanisms.

Table 9-2: Projected environmental benefits of AGG. The table indicates projections for avoided deforestation, climate change mitigation, and water savings associated with AGG compared to agricultural development under the original Blueprint strategy.

Environmental Benefit	2015	2020	2025	2030
Avoided deforestation *(hectares)*	**10,519**	**49,180**	**135,146**	**302,766**
Annual mitigation potential from agricultural practices *(tons CO_2-eqivalent per year)*	14,866	65,012	175,702	419,374
Cumulative mitigation potential from agricultural practices *(total tons CO_2-eqivalent as of each date)*	14,866	139,344	575,094	1,697,275
Cumulative mitigation potential from avoided deforestation *(total tons CO_2-eqivalent as of each date)*	922,659	4,313,754	11,854,023	26,556,514
Cumulative mitigation potential from all sources *(total tons CO_2-eqivalent as of each date)*	**937,526**	**4,453,098**	**12,429,117**	**28,253,789**
Water savings *('000 cubic meters per year)*	**14,029**	**109,483**	**342,000**	**941,715**

Figure 9-2: Projected deforestation outcomes. The figure indicates cumulative deforestation attributable to agricultural expansion within the Southern Corridor under the AIPP (agricultural intensification with prevailing practices) and AGG (Agriculture Green Growth) scenarios. These estimates do not include deforestation attributable to charcoal production, logging, or other causes.

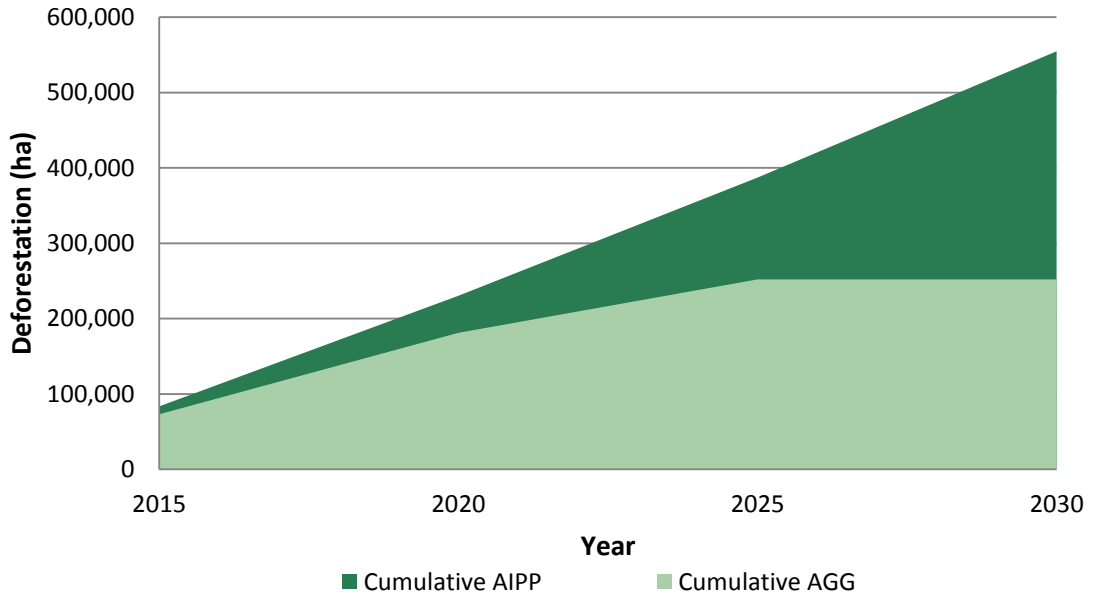
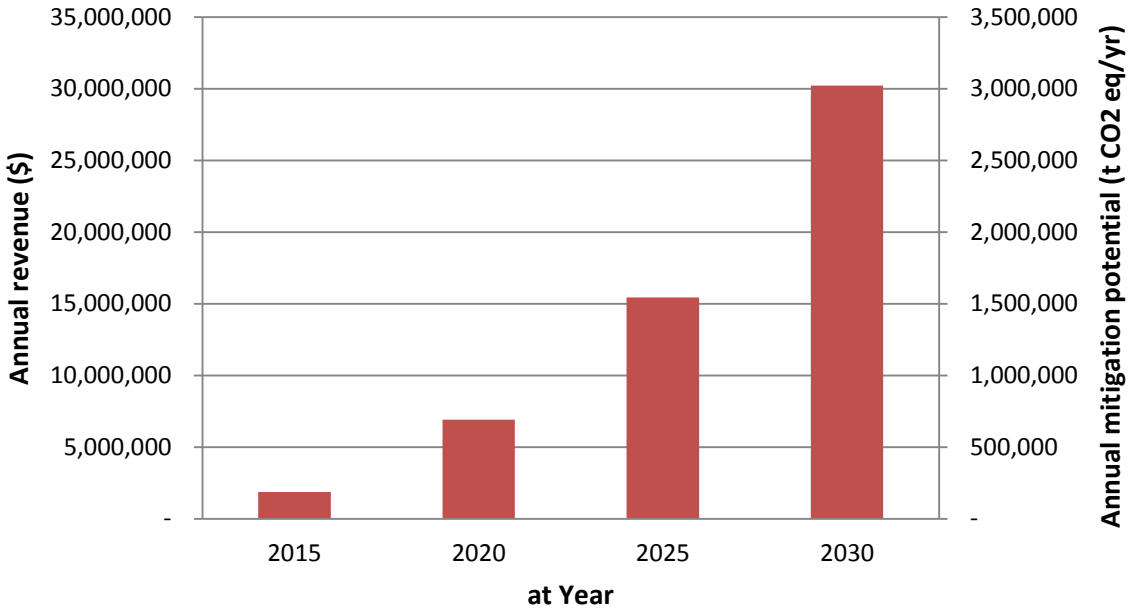
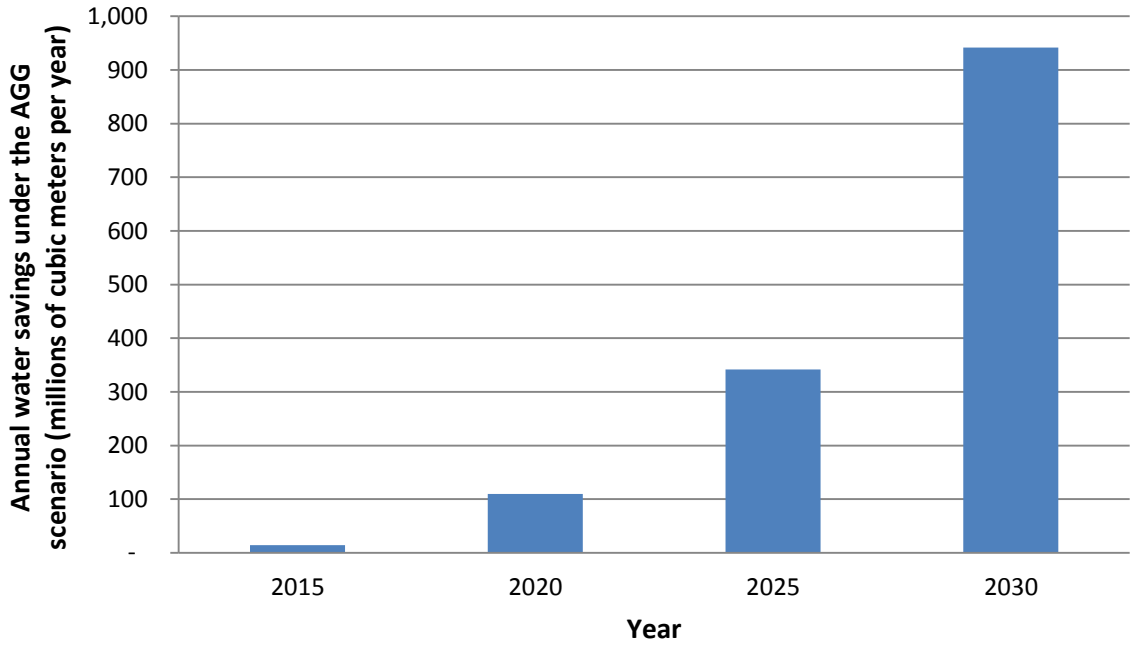


Figure 9-3: Projected greenhouse gas mitigation potential of the AGG strategy. Total mitigation potential has been calculated by summing the CO_2-equivalent value for all relevant greenhouse gases. The potential monetary value of carbon credits associated with these mitigation outcomes is calculated on the basis of recent carbon prices of US $10 per ton of CO_2-equivalent (t CO_2-eq).



The AGG strategy will also generate annual water savings of about 940 million cubic meters (760,000 acre-feet) per year on irrigated land (Table 9-2 and Figure 9-4).[32] By becoming more water-efficient, farmers will be able to lower costs and reduce susceptibility to climatic variability. In addition, precious water resources will be conserved for "environmental flows" (i.e., keeping water in streams to support wildlife habitat and other downstream uses) and to supply hydroelectricity facilities at the Mtera, Kidatu, and other key dams.

Figure 9-4: Projected reduction in agricultural water usage. The figure indicates the estimated annual reduction in irrigation water usage under the AGG (Agriculture Green Growth) scenario compared to the AIPP (agricultural intensification with prevailing practices) scenario.



An Inspired Vision, A Practical Strategy

The SAGCOT Initiative offers an inspired vision of what could happen if farmers, communities, investors, government, and civil society come together to tackle the challenges of food security, poverty, environmental degradation, and climate change in southern Tanzania. Taken together, the SAGCOT Blueprint and this Greenprint lay out a practical strategy—and an attainable investment program—to realize this vision.

The development projections summarized above offer a glimpse at what Agriculture Green Growth could achieve by the year 2030. The projections indicate that well-planned and coordinated investment, together with robust support for farmers and rural communities to sustainably intensify agriculture with appropriate technologies and practices, can simultaneously reduce poverty, ensure food security, and conserve Tanzania's ecosystems and natural resource base. It can capture new synergies between sectors, communities, and businesses that once worked separately, or at cross purposes. If Tanzania commits to making the Southern Corridor a fertile ground for Agriculture Green Growth, millions of people will reap the benefits.

[32] Additional water savings on rainfed lands are certain to occur, but the effect of these savings on watershed condition depends heavily on a number of management and hydrological factors that are beyond the scope of the impact models.

Annex A: Glossary

Agriculture Green Growth: An approach for attracting and coordinating investment in agricultural production, processing and distribution that is efficient, profitable, sustainable, and resilient to climate change.

Block farming: A farming system in which groups of smallholder farmers join together to farm large tracts under the guidance of a technical supervisor in order to minimize labor, input and extension costs.

Climate-smart agriculture: An approach to food production that sustainably improved productivity, increases resilience, and reduces net greenhouse gas emissions while enhancing the achievement of national food security and development goals.

Conservation agriculture: A farming approach that manages soils, cropping cycles, crop residues, and other natural resources to increase yields, improve soil health, and reduce environmental impact. The system includes three core practices: 1) minimizing tillage and other soil disturbance, 2) maintaining permanent soil cover, and 3) diversifying crop rotations. Conservation agriculture is used for a wide variety of the crops including maize, sunflower, beans, peas, sorghum, and vegetables. It can be readily adapted to both small- and large-scale farms.

Green Economy: Economic development that improves human well-being and social equity while reducing environmental risks and scarcities. As a contemporary form of sustainable development, the green economy recognizes the monetary and non-monetary values of ecosystems for human well-being, and incorporates these values into strategic decision-making. A green economy also emphasizes the importance of resource use efficiency, reduced carbon emissions, and inclusive growth benefitting all sectors of society.

Green Growth: A development model that links economic growth and human wellbeing in all sectors (food production, energy, water, transport, housing, etc.) to sustainable resource management. The concept is similar to Green Economy.

Outgrower scheme: A system under which small-scale farmers (outgrowers) produce crops for sale to a specific purchaser, usually an agricultural processing operation or nearby large-scale farm. Frequently, the outgrowers receive training, extension, and input supplies to help improve product quantity and quality.

Precision agriculture: A farm management approach that monitors and manages variability within crop fields or animal herds in order to apply the optimal quantity of inputs at the optimal locations and times. By doing so, farmers using precision agriculture can often achieve comparable or greater yields with fewer inputs, thus improving production efficiency and profitability while reducing environmental impacts. Precision agriculture generally uses modern technologies such as sensors, enhanced machinery, and geographic information systems to provide optimal management.

SAGCOT: The acronym SAGCOT is used in this report to refer to the SAGCOT Initiative. The geographic area defined as the Southern Agricultural Growth Corridor of Tanzania is referred to as the "Southern Corridor."

System of Rice Intensification: A farming system for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. Compared to conventional rice cultivation, SRI methods reduce the applications of water so that fields are intermittently but not continuously flooded; reduces seed densities; applies systematic seedling spacing; and reduces the usage of chemical fertilizers and pesticides while increasing soil organic matter.

Sustainable intensification: A broad term referring to strategies that increase the amount of food produced per unit of land, but without negatively affecting the environment or natural resource base.

Whereas conventional strategies intensify agriculture by applying more chemical fertilizer, pesticides, water, and energy, sustainable intensification does so mainly by improving input use efficiency and promoting ecological processes (e.g., nutrient cycling, soil fertility, water harvesting, pest control, and pollination) that increase the biotic and abiotic productivity of the farm. Sustainable intensification can combine these ecologically-based practices with judicious use of modern technologies and practices, including agrochemicals, hybrid or genetically modified seeds, and modern farm machinery.

Annex B: Agriculture Green Growth Opportunity Analyses

This Annex presents seven Agriculture Green Growth (AGG) Opportunity Analyses, which assess some of the "best bet" AGG strategies described in Chapter 4. These analyses include a detailed description of the practice or innovation; its benefits; and key opportunities, barriers, and strategies for scaling-up the innovation in the Southern Corridor. The Annex includes the following Opportunity Analyses:

- Opportunity Analysis #1: Conservation Agriculture
- Opportunity Analysis #2: System of Rice Intensification
- Opportunity Analysis #3: Precision Agriculture
- Opportunity Analysis #4: Sustainable Intensification of Beef Production
- Opportunity Analysis #5: An Enterprise Approach to Community Forestry
- Opportunity Analysis #6: Differentiated Markets for Sustainable Agriculture
- Opportunity Analysis #7: Building a Tanzania-Led AGG Finance Pipeline
- Opportunity Analysis #8: Payments for Ecosystem Services (PES)

SAGCOT Agriculture Green Growth: Opportunity Analysis #1
Conservation Agriculture

WHAT IS CONSERVATION AGRICULTURE?

Conservation agriculture (CA) is a farming approach that manages soils, cropping cycles, crop residues, and other natural resources to increase yields, improve soil health, and reduce environmental impact. The system includes three core practices: 1) minimizing tillage and other soil disturbance, 2) maintaining permanent soil cover, and 3) diversifying crop rotations. CA can be used for a wide variety of the crops grown in the corridor including maize, sunflower, beans, peas, sorghum, and vegetables. It can be readily adapted to both small- and large-scale farms.

The three core CA practices can be adapted and combined with other practices, depending on the local context. For instance, in dry areas, planting basins can be used to increase moisture availability to crops and concentrate fertilizer at the crop root. On large farms, specialized machinery such as tractor-driven direct-seeding planters are used, whereas simple hand- or animal-driven tools and machines are used by small-scale farmers. Although organic or inorganic fertilizers are usually needed to obtain maximum yields, CA is also an excellent strategy for increasing productivity when fertilizers are not available or affordable. Good quality seeds and appropriate seed spacing are critical in all cases.

In Tanzania, Zambia, and other African countries, farmers use the "evergreen agriculture" system to combine CA with the planting of *Faidherbia albida* fertilizer trees. Interspersed with maize or other crops, these trees provide an abundant source of nitrogen, but do not compete for light because they drop their leaves in the rainy season. Pods of this tree are also an excellent dietary supplement for livestock. Other leguminous species such as cowpea, pigeon pea, and *Gliricidia* may also be used as intercrops to supply nitrogen fertilizer.

As seen by these examples, CA must be locally adapted to each farm or community; it is not a simple recipe or technology package. For this reason, extension, farmer training, and farmer experimentation are critical. Equipped with basic knowledge about CA principles and access to technical support, farmers across Africa have shown great capacity to apply and adapt CA to a wide range of contexts.

CURRENT AND PRIOR EXPERIENCE WITH CONSERVATION AGRICULTURE

CA has been demonstrated as a win-win-win solution for yield, profitability, and environmental conservation. For this reason, farmers have adopted CA across more than 110 million hectares worldwide, while many government and donor programs have supported CA in Africa.

Potential benefits

CA has several important benefits that are widely observed:

- Yields generally increase relative to conventional farming techniques. For instance, across a wide range of settings, yield increases for maize have typically been 20-120%, and often higher.
- Income increases as higher yields are often combined with lower input costs.
- Soil erosion decreases while rainfall infiltration increases. Moisture conservation reduces farmers' susceptibility to drought and reduces the risk of crop failure.
- Overall, labor requirements decrease and are spread more evenly throughout the year.
- CA systems generally use less water per unit of crop produced than conventional agriculture.

Although CA is broadly beneficial to farmers, it is important to note that sometimes CA does not generate net benefits in its first year, or even its first few years. Farmers may initial face higher labor demands, greater weed problems, or the need to buy new machinery. To overcome this hurdle may require access to loans, establishment of long-term demonstration sites or model farms, long-term extension, or some combination of these.

Current uptake in SAGCOT and beyond

CA first came to the corridor in the 1990s. In the Southern Highlands, particularly drought affected areas in Mbeya and Njombe, CA has begun to take hold through long-term extension and farmer field schools. Smallholders in these districts have seen their maize and sunflower yields more than double on average, with less labor, leaving time to cultivate more land or save money by not having to hire help during the planting season. The Alliance for a Green Revolution in Africa is beginning to promote CA for maize/legume intercrops in Mbeya and Sumbawanga districts. However, despite the efforts of various projects and initiatives to promote CA in southern Tanzania, the approach is still not very widely used.

POTENTIAL AND BARRIERS FOR SCALING-UP IN SAGCOT

Because CA is so adaptable to a wide range of contexts, it holds great potential throughout the corridor. However, several areas should be considered as particular priorities for CA investment to increase yield and food security while reducing risk. In the smallholder sector, these areas include:

1) Agricultural zones where maize is the dominant or preferred crop and rainfall is insufficient to ensure a consistently good crop.
2) Agricultural zones subject to significant soil degradation.
3) Agricultural zones where the unavailability or sensitivity of nearby land compels farmers to intensify production on existing plots, but with little access to fertilizer or irrigation.

For large-scale agriculture, CA may be promoted widely for new and existing farms growing maize, sunflower, and various types of beans and legumes.

If widely adopted in the SAGCOT region, CA could have very significant benefits for agricultural output, profitability, and environmental quality. Table C1-1 estimates the impacts of CA if applied to maize-growing areas in Mbeya Rural district. These yield estimates are conservative because they are based on the experience of farmers in Mbeya using little nitrogen fertilizer. With access to fertilizer, yields and water-use efficiency could both increase significantly.

Despite the significant potential benefits of CA, several barriers have impeded widespread adoption in southern Tanzania. For small-scale farmers, the greatest impediment is lack of information and technical assistance to design context-appropriate CA farming systems. Most parts of SAGCOT lack the dense network of government, private, or non-governmental (NGO) extension services that is needed to introduce and demonstrate new practices; set up demonstration plots, farmer field schools, or other outreach methods; and help farmers experiment and problem-solve as they introduce the new practices on their own land.

Limited access to inputs is another important constraint. To perform well, CA requires quality seeds, including seeds for rotation crops or cover crops that may not currently be widely available. Herbicides and fertilizers may also assist with the initial establishment of the farming system, and support ongoing productivity. Finally, CA requires new tools such as direct-seeding planters or rippers. Agro-dealers must be trained or assisted to source and sell such tools, or, alternatively, local artisans may be trained to create suitable locally-built tools.

Table B1-1: potential benefits of CA adoption on maize farms in Mbeya Rural district.

Outcome	Current condition	With CA	Net change
Area under maize cultivation (ha) (a)	53,000	53,000	0
Yield (tons/ha) (b)	1.5	2.6	+1.1
Yield (tons)	79,000	137,800	+58,800
Crop value (USD) (c)	18,328,000	31,969,600	+13,641,600
Crop water efficiency (liters use per ton of maize) (d)	3,200,000	1,800,000	-1,400,000
Total water use (liters)	253 billion	248 billion	-5 billion
Soil carbon storage (tons) (e)	baseline condition	additional ~500,000 to 1,000,000	+500,000 to 1,000,000

(a) Ministry of Agriculture statistics
(b) Current yield: Ministry of Agriculture statistics. CA yield: averages from the Mbeya case study from "Conservation agriculture as practiced in Tanzania: three case studies"
(c) Based on 2008 maize price in Mbeya of $232/ton
(d) Mean estimates from "Conservation farming strategies in East and Southern Africa: yields and rain water productivity from on-farm action research" (J. Rockstrom et al. 2009)
(e) Based on literature review in "Performance and potential of conservation agriculture for climate change adaptation and mitigation in sub-Saharan Africa" (Milder et al. 2011)

Large-scale farmers are less likely to face severe constraints related to knowledge and inputs, but more likely to face constraints related to the availability of suitable machinery, such as direct-seeding tractor attachments. Such equipment will likely need to be imported. In addition, if large-scale farmers are not facing severe erosion problems, and if labor is abundant and inexpensive, they may have insufficient incentive to switch from conventional tillage-based systems. However, CA can provide a variety of public benefits such as improved water-use efficiency, reduced erosion, and reduced water pollution. Policies can be designed to encourage farmers to consider such factors in their choice of farming system.

Box B1-1. Getting to Scale: Lessons from CA Initiatives in Zambia and Kazakhstan

Several countries around the world have successfully scaled-up the use of CA through combinations of farmer innovation, support, and policy. Tanzania can learn from these successful examples as it seeks to promote CA in the corridor. Two contrasting experiences—from Zambia and Kazakhstan—illustrate different approaches that Tanzania could follow to scaling up CA adoption. The Zambian case focuses on CA adoption for small-scale farmers, while the Kazakhstan example focuses on adoption by large-scale, mechanized farmers.

In Zambia, the government first turned to CA in the mid-1990s after years of prolonged food insecurity among small-scale farmers, even in years of good rainfall. The government established the Conservation Farming Unit (CFU) in 1995 and, in 1999, formally endorsed CA as government policy and as a focus of the national extension program. With support from the World Bank and others, the government trained 620 field extension workers in CA techniques; set up a network of demonstration farms and learning plots; and established simplified CA implementation protocols for each agroecological region. Simultaneously, multiple sources of government, donor, and NGO support to the smallholder agriculture sector—including input packages, input subsidies, and food-for-work programs—were aligned to encourage the adoption of CA. As a result of these programs and the dedicated extension and outreach work by the CFU and its partners, uptake of CA spread from 20,000 small-scale farmers in 2001 to an estimated 250,000 (30% of all Zambian smallholders) in 2011.[33]

In Kazakhstan, wheat farming areas were in decline in the 1990s after the collapse of the Soviet Union. Low levels of rainfall, strong wind, and poor soil management led to serious erosion and soil degradation, combined with falling

[33] For further information, please see "Conservation agriculture in Zambia: a case study of Southern Province," by F. Baudron et al. (FAO, CIRAD, ICRAF, and ACT, 2007).

yields. In this context, the Food and Agriculture Organization (FAO) worked with ministries of agriculture in Kazakhstan and nearby parts of Mongolia to establish nine CA demonstration plots of 100 ha each. The system included no-tillage, mechanized direct seeding, retention of crop residues, chemical weed control, and crop rotations where possible. The demonstrations showed significant yield increases, along with reductions in fuel and labor costs. CA also provided more reliable yields during drought years. Economic returns to farmers were negative in the first year due to the need for up-front investment, but turned positive by the second year, and yielded an overall internal rate of return (IRR) of 28%.

On the strength of these trials, the Government of Kazakhstan established a package of supportive pro-CA policies. Critical to this effort was political commitment from the highest levels, which filtered down to ministry and sub-national actions. For instance, the CA approach was promoted within public and private extension services, and the government provided initial subsidies for herbicides and no-till seeding equipment to overcome the first-year investment hurdle. The government also waived protectionist policies in the agricultural machinery sector to permit the importation of no-till seeding equipment. These policies unleashed rapid innovation and uptake by the private sector. In 2004, CA was practiced on less than 1,000 hectares in Kazakhstan. By 2011, CA had spread to 1.6 million hectares, while conservation tillage is now used on an additional 10 million hectares in northern Kazakhstan.[34]

WHAT WOULD IT TAKE TO SCALE-UP EFFECTIVE ADOPTION OF THIS AGG INNOVATION?

As the experience from Zambia, Kazakhstan, Brazil, and other countries demonstrates, there are several different approaches to promote CA. All of them, however, involve working directly with farmers to share knowledge, demonstrate productive and profitable practices, and make available the necessary inputs and tools.

In SAGCOT, the most important and cost-effective strategy for scaling-up CA is likely to be the establishment of CA-oriented extension services. Many good models for participatory extension for CA already exist, such as those used by CARE in Morogoro region. Extension services may be provided by a combination of government, private, and NGO extension workers. As was done in Zambia, the government could establish a network of CA training centers throughout the corridor where extension workers, agriculture officers, and agro-dealers would be trained in CA practices and made familiar with the input, financing, and technical assistance resources available to farmers. This "knowledge resource" could be complemented by supportive government policies (such as input subsidies) to encourage CA adoption. Finally, existing programs to work with agro-dealers on input supply chains (e.g., programs supported by AGRA) could be adapted to ensure that agro-dealers carry the seeds, herbicides, and equipment needed to implement CA in an optimal fashion.

Since the "yield gap" between current and potential crop production is generally much greater for small-scale farmers than for large-scale farmers in the corridor, public-sector support for CA is likely to be most cost-effective if oriented toward small-scale farmers. However, there is also great potential for large-scale farmers to use CA to increase yield and profitability while reducing environmental impacts. The SAGCOT Centre or appropriate personnel in the Ministry of Agriculture could work with prospective large-scale investors to identify and help overcome specific constraints to CA. In addition, as mentioned above, agricultural policy related to input subsidies, water, and other factors can shift the incentives for large-scale farmers to encourage the adoption of CA.

[34] "Conservation agriculture in northern Kazakhstan and Mongolia," by S. Hickmann. (FAO, 2006). "Adoption of conservation agriculture and the role of policy and institutional support," by T. Friedrich, A. Kassam, and F. Thaer (FAO, 2009).

RESOURCES

Ample resources on CA are available on the internet. A few of particular relevance to SAGCOT include:

- Conservation agriculture case studies for Tanzania and Zambia: www.fao.org/ag/ca/doc/Tanzania_casestudy.pdf; www.fao.org/ag/ca/doc/Zambia_casestudy.pdf
- Zambia conservation farming unit: www.conservationagriculture.org/CFU/index.html
- African Conservation Tillage Network: ACT has a range of resources and publications on CA. They also offer trainings for agriculture and extension staff. Website: www.act-africa.org.

SAGCOT Agriculture Green Growth Opportunity Analysis #2
System of Rice Intensification (SRI)

WHAT IS THE SYSTEM OF RICE INTENSIFICATION?

Originally developed in Madagascar in the 1980s, SRI is an agroecological methodology for increasing the productivity of irrigated rice by changing the management of plants, soil, water and nutrients. Its methods have been adapted also to upland rice production in several countries, and now also to other crops, called System of Crop Intensification (SCI) in India and "planting with spacing" in Ethiopia, improving productivity also for wheat, finger millet, sugarcane, and teff, for example.

SRI practices, based on sound agronomic principles, seek to create optimal growing environment s for crops above and especially below ground. Compared to conventional cultivation, SRI methods reduce the applications of water (no flooding for irrigated rice), seed rates (reduced plant populations), and use of chemical fertilizers and pesticides (relying more or even completely on organic inputs). The resulting crops give higher yields, more net income, and greater labor productivity. SRI does require more knowledge and skill, and initially more labor. Because SRI enables farmers to reduce their inputs and lower costs of production, household incomes can increase by more than the increase in yield.

SRI practices, suitably adapted to local conditions, raise the productivity of land, labor and water by improving soil structure and functioning, facilitating root growth, and promoting the biodiversity and activity of beneficial soil organisms. Six main practices are usually recommended for SRI:

1) transplanting young seedlings (8-12 days old), moved quickly and carefully from the nursery into the field,
2) spacing plants in a square grid pattern, usually 25 cm apart,
3) planting only 1 seedling or sometimes 2 seedlings per hill, with roots placed carefully just under the soil surface,
4) applying water to the field intermittently, with no continuous flooding,
5) weeding several times, starting at 10-12 days after transplanting, preferably with a mechanical weeder which aerates the soil, and
6) providing organic matter to the soil, as much as possible, complemented with targeted chemical fertilizer if needed.

CURRENT AND PRIOR EXPERIENCE WITH SRI

Reports of SRI's success in raising resource productivity have come in from almost 50 countries around the world (see http://sri.ciifad.cornell.edu) and this simple set of practices is becoming increasingly recognized as an important component of climate-smart agriculture in rice systems. We are interested to hear what opportunities you see for taking advantage of SRI methods and where SRI could be practiced within the SAGCOT.

Potential benefits

SRI has several benefits that are widely seen in addition to improving yields and household incomes:

- Because irrigated rice is grown with a minimum of water or alternate wetting and drying, there is usually considerable savings of water, 30-50%, and much greater crop per drop. This is increasingly important in water-constrained areas.
- Crops grown with SRI methods are generally more drought-resistant and able to resist storm damage because of better root systems and more robust canopies.

- They are also more resistant to pests and diseases, making application of agrochemicals less necessary and less profitable.
- SRI paddy (unmilled) rice usually gives 10-15% higher outturn of polished (milled) rice because of fewer unfilled grains (less chaff) and more whole grains (less breakage), which further adds to food supply and rice profitability.
- Soil quality and fertility are enhanced by the amendments of organic matter and by plant root exudation. When combined with conservation agriculture (CA), e.g., on permanent raised beds, there is further improvement of fertility, reduction of erosion, and utilization of rainfall.
- While more labor time is required initially, as the new methods are learned, farmers in most Asian countries have found SRI cultivation to be labor saving, and usually women's labor burdens are reduced.

SRI is not necessarily an 'organic' methodology, as chemical fertilizer can be used with the other methods. Where the soil is not very fertile, this may be advisable. But factorial trials have shown that very high yields can be obtained with organic SRI production, and the cost savings for farmers can make this more profitable. The management practices usually build up soil fertility over time, so that higher yields can be obtained with further reductions in the number of plants per m^2.

Many of the SRI practices are counter-intuitive, but experience is showing that higher yields can be obtained with less inputs of seed, water, labor and cash. Initially SRI was discounted as 'too good to be true,' and African farmers were often averse to intensified management, which required more attention and time. But expansion of SRI use in Mali, Kenya and Burundi, starting from knowledge gained from Madagascar, has shown the potential of SRI in the continent.

- In Vietnam, where less than 10,000 farmers were using the methods in 2007 when the Ministry of Agriculture and Rural Development officially endorsed SRI, based on its own evaluations, the number grew to over 1 million farmers in four years' time.
- In China, SRI use in Sichuan province has spread from 1,133 ha in 2004 to over 300,000 ha in 2010. The extra 1.66 million tons of paddy rice produced by SRI farmers, and attributed to the new methods by the Provincial Department of Agriculture, were valued at over USD 300 million.

Unlike many innovations moving to more agroecological management which may not give immediate or short-term benefits, SRI usually is more profitable from the first year. As confidence and skill in the methods builds up, yields rise further while costs of production, including labor input, decrease. This is observed for most other crops improved with these ideas, such as wheat, finger millet and teff.

- In Tigray province of Ethiopia, where finger millet yields are normally about 2.8 tons/ha, the Institute for Sustainable Development (ISD) in Addis Ababa reports with SCI practices called 'planting with spacing,' yield has reached 7.6 tons, with as many as 39 panicles (heads) on a single plant.
- Yields of teff, the nationally preferred cereal grain in Ethiopia, which are usually about 1 ton/hectare, have increased to 4.8 to 6.0 tons with modified crop management. Transplanting young seedlings and other SRI practices adapted to teff produce plants that have many times more tillers and larger panicles. STI is now being promoted by the Ethiopian Government's Agency for Transformation of Agriculture.

Current uptake in SAGCOT and beyond

In 2009, Kilombero Plantations Ltd. (KPL) piloted a program for smallholders providing training and tools for growing rice with SRI methods. In the first year, with the help of extension services from an expert from the International Crop Research Institute for the Semi-Arid Tropics (ICRISAT), fifteen demonstration plots were established on neighboring farms.

In 2010, with improved seed from KPL, each of the fifteen farmers in the pilot group planted 0.25 acres with the SRI methodology on their small 2.5 acre farms. Yields from the first trial were double the local average of 2.9 tons/ha, between 4.7-7 tons/ha.

In 2011, the program expanded to include 250 new farming families who were given improved seeds and special tools for implementing SRI, along with training workshops in SRI practices. Again, yields were more than doubled, increasing production from 2-3 tons/ha to 5-8 tons/ha. Two of the fifteen pilot group farmers who expanded SRI cultivation on their farms had average yields of 6.2-6.9 tons/ha. This year 1,350 new farmers will be trained, on track with KPL's goal to train 4,000 smallholder farmers in SRI in four years.

POTENTIAL AND BARRIERS FOR SCALING-UP IN SAGCOT

Since SRI practices are usually different than traditional rice cultivation methods, investment in adequate extension is needed from the government and NGO extension programs. Also, while SRI has been successful in rain-fed agriculture systems, SRI with irrigation can improve the regional average of about 2 tons/ha to 10 tons/ha. Access to appropriately designed and built, but simple, mechanical hand weeders will enhance yield and economize on labor time. Motorized mechanical weeders are being developed in India, Malaysia and Philippines, so importing some of these on a trial basis, and possibly starting local artisan manufacture of these implements, could increase the attractiveness of SRI and accelerate adoption.

Box B2-1. Getting to Scale: Lessons from SRI Initiatives in Bihar State, India

Bihar is one of the most impoverished states of the country. SRI was introduced here in 2007 by an NGO (PRADAN), with 128 farmers. By 2010, the number had expanded to 19,911, with the state-supported Bihar Rural Livelihood Promotion Society (BRPLS) using World Bank (IDA) funding to enable PRADAN and several other selected NGOs to train and supervise community-based NGOs and farmer organizations to spread SRI knowledge further. 2010 was a drought year, but average SRI yields, 3.22 tons/ha, were double those that the same farmers got with their usual crop management methods on the same farms, 1.66 tons/ha. The normal average paddy yield in the state is 2.3 tons/ha.

The NGOs trained government extension staff as well so that the Department of Agriculture became a source of farmer support for SRI. In 2011, the government's goal was 10% of the state's total paddy area, and in 2012, this target was raised to 40%, 1.4 million ha.

In the kharif season 2011, one first-time SRI farmer reached a yield of 22.4 tons/ha, measured by DOA personnel with hundreds of observers and accepted as a new world record by the Indian Council for Agricultural Research. Four other farmers in the same village reached 19 or 20 tons/ha. These farmers, who planted hybrid varieties, relied primarily on organic fertilization (green manure, vermicompost, and P-solubilizing bacteria), supplemented with just 40 kg of N. With conventional crop management, these hybrids on the same farms produced only about one-third as much as with SRI cultivation methods.

In Bihar, the uptake of new management methods for growing wheat in the winter season has spread even more rapidly. In 2008-09, 415 farmers, mostly women, tried out SWI under PRADAN guidance. In the next two seasons, the number expanded to 25,235 and then 48,521 farmers, with BRLPS supporting the work of NGOs which in turn worked with both community organizations and state extension personnel. The spread was fueled by good results, as with SRI; In 2009-10, average wheat yields were 4.5 tons/ha with SWI management compared with 1.6 tons/ha using farmers' usual methods. SRI methods have been adapted to other crops in Bihar: mustard, legumes, tomatoes, chillies, even eggplant.

WHAT WOULD IT TAKE TO SCALE-UP EFFECTIVE ADOPTION OF THIS INNOVATION?

Investment from the private, civic and public sectors will be needed to facilitate the adoption of SRI in SAGCOT. Already KPL has invested in irrigation and capacity development for the Magneta farm; similar investments in small-scale irrigation for smallholders could dramatically boost regional productivity for rice. Other investments in financial products for smallholders, like credit and loans, would help farmers to access the capital needed to purchase farm implements and improved varieties for SRI. Investment is needed in cost-effective farmer-to-farmer extension, facilitated by NGOs as well as public-supported extension services. Investment is needed also in small businesses to build and sell simple and inexpensive implements. Opportunities for extension, irrigation and financial products are each complex themes that require further consideration, so each of these topics will be addressed in turn by future agriculture green growth opportunity analyses.

Other measures that would contribute to the scaling up of SRI and SCI practices involve developing markets for local rice varieties that can be very popular with consumers, in Tanzania and abroad. It would be worthwhile and cost-effective to test which local varieties respond best to SRI management and can command the highest market price to boost farmers' profitability.

RESOURCES

Ample resources on SRI are available on the internet. A few of particular relevance to SAGCOT include:

- Africare, Oxfam America, WWF-ICRISAT Project. 2010. More rice for people, more water for the planet. WWF-ICRISAT Project, Hyderabad, India. http://www.oxfamamerica.org/files/more-rice-for-people-more-water-for-the-planet-sri.pdf
- Goud, V. V. 2010. SRI in Tanzania. *System of Rice Intensification WWF Newsletter* 2(1), January-March 2010. http://www.scribd.com/doc/41901944/System-of-Rice-Intensification-WWF-Newsletter-Vol-II-Issue-1-Jan-March-2010
- SRI - Achieving More with Less: A New Way of Rice Cultivation. A multimedia toolkit produced by the World Bank Institute. http://sri.ciifad.cornell.edu/extmats/engmanual.pdf Also see, toolkit with videos: http://vle.worldbank.org/moodle/course/view.php?id=336.
- How to Help Rice Plants to Grow Better and Produce More: Teach Yourself and Others. System of Rice Intensification website. http://sri.ciifad.cornell.edu/extmats/engmanual.pdf
- Flooded Cellars video on YouTube depicting the spread of SRI from Madagascar to Rwanda to Burundi http://www.youtube.com/watch?v=AbU7_i9vW_w

SAGCOT Agriculture Green Growth: Opportunity Analysis #3
Precision Agriculture

WHAT IS PRECISION AGRICULTURE?

Precision Agriculture (PA), also named Precision Farming, is a farm management approach that uses technologies such as sensors, enhanced machinery, and enhanced information systems to improve plant health and productivity, increase input use efficiency, increase profit, and reduce environmental impact. The core underlying principle of PA is to monitor and manage variability within crop fields or animal herds in order to apply the optimal quantity of inputs at the optimal locations and times. In this way, farmers can achieve comparable or greater yields with fewer inputs, thus improving production efficiency and the sustainability of agriculture. PA has the potential to be a core Agriculture Green Growth (AGG) strategy for SAGCOT due to its strong win-win potential for enhancing productivity, profitability, and environmental quality.

As it has been adopted on large commercial farms, PA emphasizes information technologies and modern precision machinery. Key practices include:

- Laser leveling of fields during land preparation, which also eliminates irrigation water runoff;
- Spatial yield monitors that assess variability in crop yields throughout a farm;
- Sub-field assessment of conditions, and adjustment of inputs, to optimize moisture and nutrients for plant growth without encouraging weed growth or wastage;
- Global Positioning Systems (GPS) guided equipment and other systems to apply inputs according to sub-field assessments, including computerized drip irrigation systems that deliver water according to plant locations and existing soil moisture conditions; and
- Real-time adaptive management based on environmental conditions (e.g., weather, pest populations).

The principles of PA may also be applied to small-scale farms through low-technology adaptations, such as fertilizer and manure micro-dosing, manual drip irrigation systems, and systematic crop monitoring.

PRECISION AGRICULTURE OUTCOMES AND BENEFITS

Key benefits of PA stem from increased input use efficiency. For farmers, a primary benefit is improved efficiency, reduced waste, and increased profit. However, the environment also benefits through reduced water use, reduced agrochemical pollution and nutrient leaching, and fewer greenhouse gas emissions. Evidence of these benefits has been widely documented through research.[35] Additional environmental benefits may include reduced erosion and improved soil structure.

Research on outcomes of PA on Brazilian sugarcane farms are relevant to the Southern Corridor, where sugarcane expansion is being targeted. Several studies have found that the use of PA on these sugar farms has been a key factor in enabling Brazilian sugarcane ethanol to be produced less expensively than ethanol derived from other feedstocks, such as corn or sugar beet in the United States and Europe. In Brazil's San Paulo state, research found that companies adopting PA were more efficient, had lower costs, higher yields, better sugarcane quality, and fewer environmental impacts than non-adopters. All of the sugar farmers that had adopted PA planned to maintain or expand its use due to these favorable results.

[35] Studies reviewed in Milder et al. 2012, "Moving Beyond Ideology to Close Yield Gaps and 'Nature Gaps' in 21st Century Agriculture: An Assessment of the Multi-Functionality of Agroecological Intensification."

CURRENT AND PRIOR EXPERIENCE WITH PRECISION AGRICULTURE

Precision agriculture has been widely adopted in areas such as the United States, Europe and Australia, while also being applied in the commercial sector in Brazil, and through research programs and limited commercial investments in Africa, Asia and Latin America. In the United States, for instance, precision yield monitoring is applied on about 40% of all wheat, corn, and soy crops, while other technologies such as GPS and variable-rate input application technology are used on 35% of the soy crop and up to 15% of other grain.

In Brazil, an estimated 50 million hectares of annual crops, 9 million hectares of sugarcane, 1 million hectares of citrus, and 2.5 million hectares of coffee, among others, use at least one PA practice. The practices most commonly used have been grid soil sampling (annual crops, sugarcane), variable rate lime and fertilizer applications (annual crops, sugarcane), auto steering tractors and harvesters (annual crops, sugarcane), yield maps (grain crops), variable rate insecticides and herbicides, optical sensors for nitrogen management (small grains, corn, sugarcane), and the use of aerial and satellite imagery for farm monitoring.

Box B3-1. Precision agriculture in sugarcane: learning from experience in Brazil and Mauritius

Research from numerous countries has demonstrated that sugarcane is ideally suited to the adoption of PA due to its tendency to be grown in large, well-capitalized operations, as well as the sensitivity of the crop to optimal agronomy and nutrient management. In Brazil and elsewhere, tractor automatic pilot technology has been successfully applied to reduce soil compaction, reduce operator fatigue and lower fuel costs, and increase speed, thereby improving productivity. Another benefit of the adoption of auto steering is an improvement in harvest operations, by allowing the harvester to cut the sugarcane rows more precisely based on crop mapping. Other PA practices such as yield monitoring have resulted in improved management of cane loading operations in Mauritius. These experiences suggest that the potential for PA in Tanzanian large-scale sugarcane operations is high. Ensuring open access to appropriate machinery and training for operators and technicians will be important in enabling adoption of these technologies.

Uptake of PA in Africa has been more limited, but there are some examples in the commercial sector. For instance, in the company Agricultura Cientifica S.A. is currently developing large scale mechanized direct seeded rice projects utilizing GPS precision surveys, design, supervision and cultivation of rice fields in East, West, and Southern Africa. By their own reporting, these strategies have accounted for a 20% overall increase in yield in some cases.[36] In Sudan, Golder Associated Africa has introduced the first auto steer tractor, which has been successful at reducing the average planting time by 60% compared with previous seasons, resulting in lower requires for tractor power and fuel.

While PA has mainly been adopted in the commercial sector by large-scale farmers, precision principles and practices are already applied in smallholder systems, including in the Southern Corridor, through such practices as drip irrigation. However, drip irrigation is found only is isolated instances, likely due to a lack of farmer demand given that increased irrigation efficiency is a low priority for many individual farmers, though it is a critical issue in terms of its aggregate benefits and impacts.

POTENTIAL AND BARRIERS FOR SCALING-UP IN SAGCOT

PA has high potential to be a core AGG approach in the Southern Corridor, particularly on large-scale farms that have or are planning to invest in modern machinery. Priority crops to target for PA adoption include sugarcane, soy, wheat, and tea. For the latter, implementation costs are generally low since tea is already grown in structured blocks and typically already has a structured yield recoding system. A

[36] For more information, see http://agrocheck.com.

specific GIS application package for integrated plantation management for tea was already under development in India in 2009.

In smallholder systems, farmers' detailed knowledge of their own fields is a great asset for supporting PA. Many farmers already use such knowledge and "mental maps" to apply variable management strategies in different parts of their fields. However, some simple tools may aid farmers in more effectively monitoring farm variability and responding accordingly. For instance, leaf color charts (LCC) and chlorophyll meters are simple, user-friendly tools for assessing crop nitrogen deficiencies so that they may be corrected before crop yields are seriously impacted. Initial reviews from farmers' cooperatives working with the LCC in Bangladesh, Philippines, Vietnam, India and Indonesia were positive. Another low cost PA technology for smallholder farmers—already in wide use in Bangladesh—is fertilizer deep placement through the use of fertilizer briquettes placed in the root zone, as an alternative to spraying or top-dressing nitrogen fertilizers. This practice has typically reduced fertilizer use by up to 40%, increased yields by 15%, and reduced water pollution from nitrogen runoff.

Water-use efficiency is a key goal of PA, and may be accomplished through drip irrigation, hand watering, planting basins, and automated technologies that dispense irrigation water based on current soil moisture and crop conditions. For instance, on a pilot precision irrigation trial on tea farms in Tanzania, soil moisture neutron probes were combined with low cost drip irrigation systems to optimize water management. The result was tea yields of 8500 kg/ha, or 17 times the yield achieved in rain-fed areas and double the yield in sprinkler-irrigated tea. Water consumption was reduced by 75% relative to the sprinkler irrigation system. Similar technology is being applied in Kenya on such high-value crops as tomatoes, where yields have increased twenty-fold. This is just one example of the technology that could be used to update some of the outdated and inefficient irrigation systems currently operating in the Southern Corridor to increase yields while making better use of the region's limited water resources.

Some of the general challenges to adopting PA for large-scale commercial farming operators have been the maintenance of highly specialized equipment, training of local technicians, and effective integration of PA into current practices. Success is also dependent on the availability of knowledgeable equipment dealers and skilled professionals who can help adapt technologies to specific crops and local conditions. For Brazilian sugarcane farmers who chose not to adopt PA, the greatest barriers were the long period of time before seeing a return on investments, operational difficulties, lack of specialized professionals, lack of information about potential, and resistance to change within companies. Potential barriers for small-scale farmers in the Southern Corridor include knowledge and training as well as access to PA tools.

WHAT WOULD IT TAKE TO SCALE-UP EFFECTIVE ADOPTION OF THIS INNOVATION?

As with every region of the world, the Southern Corridor will need to adopt its own context-appropriate mix of PA strategies, both high-technology and low-technology. The Government of Tanzania, civic sector, and SAGCOT stakeholders can take several actions to promote beneficial uptake of PA:

1) Appropriate PA tools, technologies, and practices can be incorporated into an AGG extension program for smallholders in the Corridor, as described in the SAGCOT Greenprint.
2) For large-scale farmers, a platform can be developed to sharing knowledge and advocate collectively for key policies or supports. A good example of such a platform is the South African Farmer's Forum on Local Development.[37]

[37] The South African Farmers Forum on Local Development (FFLD) is an interactive dialogue platform for development and commercial agriculture aiming to promote agribusiness. The objectives of the forum are to support farmers with information on precision agriculture, access to markets, best farming practices, mechanization and efficient farm management approaches, and to increase profitability; to promote shared resources among local

3) General awareness-raising about PA and its potential benefits can be achieved through multiple channels, including as part of the SAGCOT agricultural investment generation program and subsequently through agricultural extension and research institutions.
4) Recognizing the potential barrier of access to highly specialized equipment—and its efficient use—the SAGCOT Centre or other entities may facilitate the development of programs to share equipment, remote-sensing based monitoring, or technicians to support farms in the efficient use and repair of equipment. This type of system may be established around the commercial farming hubs that are proposed in the Blueprint. Agro-dealers and consultants can also play an important role in providing such services.

Additionally, more research is needed to understand the specific technologies that could best deliver PA management and benefits for both large-scale and small-scale farmers in the Southern Corridor. Place-specific data on precision management practices and outcomes should be shared and analyzed systematically so that localized management recommendations may be developed for farms who wish to increase yield and efficiency. The Afsis project is currently developing digital soil maps for all of Africa, which could later be utilized as a national GIS database to develop targeted recommendations for nutrient application rates for different crops in different portions of the Southern Corridor.[38] Such web-based GIS systems that offer farmers free information via the Internet on soil properties, soil fertility and nutrient status and help to plan agricultural land use are already popular in government programs in Korea, Taiwan and Japan. Other applications of such a national database in Tanzania could utilize text messaging to provide information and answer services, including information on best practices, climate conditions and effects, and yield volume predictions. General farmer information kiosks and local knowledge centers offering weather and market information have already been scaled-up in Africa through a number of government and donor programs, and could be expanded in the Southern Corridor to include science-based information services on farm and crop specific advice for use of PA approaches.

For small-scale farmers, on-farm adaptive research facilitated through participatory extension programs, Farmer Field Schools, and other methods can help farmers adapt specific technologies to local soil, crop and environmental conditions.

RESOURCES

Key resources on PA of relevance to SACGOT:

- *Precision Agriculture* (http://www.springer.com/life+sciences/agriculture/journal/11119). Precision Agriculture is a peer-reviewed scientific journal. The full text of articles are available online.
- *Precision Farming: A Comprehensive Approach,* Virginia Cooperative Extension, Virginia Tech, and Virginia State University (http://pubs.ext.vt.edu/442/442-500/442-500.html, This resource provides a good overview of terminology and basics of precision farming in an easy-to-access format. It provides links to a number of extension fact sheets for specific technologies.

farmers through business to business relations, among others. More information can be found on the website http://www.farmersforum.co.za/.

[38] For more information see http://www.africasoils.net.

SAGCOT Agriculture Green Growth: Opportunity Analysis #4
Sustainable Intensification of Beef Production

[further editing needed for the final draft]

WHAT IS SUSTAINABLE INTENSIFICATION OF BEEF PRODUCTION?

Sustainable intensification of livestock production involves management to increase meat or dairy output per unit area, while reducing overall impacts on the environment. As with sustainable crop intensification, the key principles of this approach include increasing input use efficiency; deliberately managing the agroecosystem to increase biological productivity, soil health, and nutrient cycling; and selecting appropriate genetic stock (livestock breeds). Specific practices include:

- Range management to increase fodder and biomass production;
- Optimization of stocking rates and grazing rotations for cattle weight gain and resource conservation;
- Adoption of locally appropriate high-yielding breeds;
- Modern reproduction and veterinary services;
- Modern slaughter and processing facilities, which, in the case of SAGCOT, can also function as hubs for processing cattle from nearby small-scale livestock keepers; and
- Protection of key natural features—including waterways and high conservation value habitats—from livestock grazing, erosion, and soil compaction. This is achieved through integrated ranch planning to identify and delineate areas for cattle pasture, ecosystem conservation and restoration, restricted and vulnerable areas and other land uses.

Currently, most livestock in Tanzania are kept in one of four farming systems: mixed farming, agro-pastoral, pastoral, and commercial. Here we focus on the commercial sector because of the "quick win" opportunities to redevelop several government cattle ranches to improve productivity, profitability, and sustainability, while establishing local processing and service hubs that benefit nearby small-scale livestock producers. Nevertheless, sustainable intensification of livestock is equally important and achievable on small-scale farms.

One approach to sustainable cattle production that has proven successful in southern Africa is holistic grazing management. This system is based on the premise that cattle can be managed (through stocking rates and rotations) to mimic the behavior of wild herbivores and thereby help regenerate native vegetation, increase range productivity, and reverse desertification. One of the most successful management practices in holistic grazing management has been the use of a mobile overnight kraal, in which livestock are kraaled on successive crop fields at night to break up the soil with their hooves and deposit nutrient rich dung and urine to fertilize the hoof-prepared soil. This practice facilitates the trampling down of old grass so the soil is covered, making it less prone to the drying effects of sun and wind. In this approach, burning is to be avoided because it exposes the soil to erosion.

POTENTIAL BENEFITS OF THIS AGG OPPORTUNITY

Investment potential in the livestock sector, including for meat, is high in Tanzania. Currently, the nation has more than 19 million cattle, but 90% of these are unimproved breeds that generally provide low yields and inferior meat quality. Despite its enormous land and water footprint, the livestock sector accounts for only 1% of Tanzania's exports, in part because little value addition is provided. Potential benefits of sustainable intensification include:

- **Increased Yield:** Results from a decade of implementation of holistic grazing management on the African Centre for Holistic Management Farm in Zimbabwe include a doubling of meat yields, a fourfold increase in forage yields, a 66% increase in litter cover, a 12% increase in perennial grasses, the restoration of degraded lands, and the renewed flow of the Dimbangombe River.
- **Improvements in Meat Quality:** Investments in abattoirs and other modern processing equipment has the potential to increase production of higher quality meats for both domestic and export markets. Existing facilities cannot meet current demand, and potential investments exist for joint ventures with existing abattoirs, purchase of semi-finished abattoirs, and construction of new abattoirs and processing facilities.
- **Improved Marketability and Product Differentiation:** Green labeling, eco-certification and supply chain standards are generating increasing interest and have great potential for improving the marketing of sustainably produced beef and dairy products in the Southern Corridor (see Box C4-1). Use of certification standards may also create opportunities for new revenue streams from the underlying ecosystem services, such as carbon credits.
- **Increased Profitability:** All of the above factors may increase farm productivity.

Box B4-1. Third-party sustainability standards: new opportunities for marketing and value addition

Third-party sustainability standards differentiate sustainable products in the marketplace, thus allowing producers to gain advantages such as increased prices and improved market access (see Opportunity Analysis #6 for additional information). Rainforest Alliance and GreenChoice Alliance/ Biodiversity and Red Meat Initiative (BRI) are two initiatives that include third-party sustainability standards for meat production.

Rainforest Alliance Certified cattle production criteria apply to pasture-fed cattle in Latin America, Asia, Africa and Oceanea. The criteria aim to meet multiple goals for economically viable beef production, biodiversity conservation, and worker wellbeing, and emphasize integrated management systems, animal welfare, sustainable pasture management, and the reduction of greenhouse gas emissions. The "critical criteria" (which must be achieved in order to attain certification) for cattle farms consist of limitations on where cattle can be purchased, the requirements for animal identification and tracking, and specifications on the types of feed and medications that may be given to cattle. Examples of the types of production and management criteria for Rainforest Alliance Certified cattle farms include conservation of trees in pasture, forest reserves or as live fences, creation or management of protected areas for natural forest buffer and shelter and migration routes for wildlife, protection of waterways, and the management of cattle and wild species interactions.

GreenChoice is a multi-stakeholder project, supported by Conservation International and WWF-South Africa with multiple goals to improve sustainable production and conservation of biodiversity. The Biodiversity and Red Meat Initiative (BRI), part of the GreenChoice Alliance, is an independent association comprised of over 50 communal livestock farmers in the Kamiesberg, Northern Cape and covers more than 21,000 ha. Some of the land management practices and criteria that farmers have agreed to follow in "stewardship agreements" as part of the BRI include land stewardship and soil and rangelands conservation, eradication of water-thirsty alien invasive plants, reduced use and improved handling of agrochemicals to reduce run-off, and conservation of riparian buffer zones to improve water quality and quantity.

OPPORTUNITIES FOR SAGCOT

National Ranching Company (NARCO) ranches where land titles are clear but ranch management is sub-optimal are ripe with opportunities for investors to enter the landscape with a number of "quick win" investments in sustainable livestock intensification. NARCO owns a total of about 519,000 hectares of land, including eight ranches comprising 230,000 hectares and an additional 289,000 hectares subdivided

into 124 small ranches and subleased to Tanzanian investors. Together, the NARCO ranches have a carrying capacity of 80,000 to 90,000 cattle under extensive management conditions with potential for very large increases (in many cases nearly 100,000 additional head of cattle per ranch) if there was a shift to intensified management with feedlots. However, current stocking is only about 28,000 cattle and 2,700 small ruminants. Key areas for investment in sustainable intensification include:

- Increasing livestock population in each of the ranches in order to attain their maximum carrying capacities. This would entail purchase of quality breeder animals, purchase of immature animals for feedlotting, infrastructure development, pasture and water facility improvement, and optimal management of feed resources;
- Investment in livestock multiplication, an area where capacity is far below demand; and
- New domestic value addition activities, such as hide processing, to capture such revenue locally rather than exporting raw hides for processing elsewhere.

Four NARCO ranches are found in the Corridor, each with specific investment opportunities for sustainable intensification. These are summarized below.

Kongwa Ranch is located 80 km east of Dodoma Municipality along the Dar es Salaam-Dodoma Highway. The ranch has 38,000 hectares. Currently, the ranch has 8,063 cattle, with capacity to hold 14,000 head. However, with optimal livestock and range management along with a shift toward feedlot management, it is estimated that the ranch could support a far great number of cattle. The ranch has basic infrastructure for livestock production, including ground water reservoirs, water reserve tanks, two cattle dips, and one mini-abattoir. The nucleus herd are all indigenous Boran cattle, which are bred strategically for herd improvement but have not been crossed with improved breeds for beef production. All cattle are pastured throughout the year. The ranch has the advantage of being connected to the National Power Grid, and the extensive area provides the opportunity to develop wind and solar power generation. Cattle fattening is also performed on the ranch with immature livestock sourced from many of the surrounding districts (Mpwapwa, Kongwa, Chamwino, Bahi, Manyoni, Kiteto, Kondoa and Simanjiro). The "Kongwas Beef" brand represents the beef from this and other NARCO ranches. The ranch has several employees and access to the National Livestock Research Institute and the Veterinary Investigation Centre for extension support.

Ruvu Ranch is situated in Coast Region in Bagamoyo District. This 43,000 hectare ranch currently has 3,762 cattle with the capacity to hold up to 10,238 head of cattle under existing conditions. As with Kongwa Ranch, implementing feedlot management at Ruvu Ranch could increase the ranch's capacity significantly. Existing infrastructure to support cattle management includes dams, one cattle dip, a modern butchering facility and one mini-abattoir. The ranch has the advantage of being close to Dar es Salaam, a major international airport and a major port. Ruvu Ranch is also connected to the National Power Grid. The ranch's location along the main Dar es Salaam – Morogoro highway, as well as the central railroad allows for easy access to domestic and international markets and relatively low transportation costs. Immature cattle are source from Bagamoyo, Morogoro, Handeni and Korogwe Districts for fattening. An export-quality abattoir and meat processing facility are construction currently. Veterinary and zoosanitary services are available in Kibaha Town and Dar es Salaam (Central Veterinary Laboratory and Kwala Zoosanitary Facility).

Mkata Ranch is located 58 km from Morogoro Town off Morogoro-Iringa Highway. There are currently 2,329 cattle on the ranch's 19,446 hectares of land, but it is estimated that the ranch has a capacity of 7,000 head of cattle under extensive management. Some infrastructure, such as a few dams, one water tank and 50 acres of fenced land are already in place for cattle management. Although the ranch lacks

some important infrastructure, it is situated near the Tanzania Pride Meat Abattoir in Mvomero District in Morogoro.The ranch has fairly developed infrastructures with dams, one water tank, and 50 acres of fencing. The ranch has the advantages of being connected to the National Power Grid, and located along the Dar es Salaam – Iringa highway and the central railroad. Mkata is also used for fattening cattle sourced from Kilosa, Mvomero, Morogoro Rural, Kongwa, Bagamoyo and Kiteto. Domestic markets include tourist hotels, power stations, Mtibwa and Kilombero Sugar Factories, as well as universities and supermarkets in Morogoro and metropolitan Dar es Salaam. Veterinary and livestock extension are available at Sokoine University of Agriculture in Morogoro. Mkata ranch has high potential for shifting to intensified feedlot production due to the close proximity of sugar processing facilities whose by-products could supplement concentrated feed.

Kalambo Ranch, in Rukwa Region, is located 45km South-west of Sumbawanga Municipality, close to the southern tip of Lake Tanganyika and the border with Zambia. The ranch currently holds 1,733 head of cattle with potential to expand extensive production up to 8,730 head of cattle. The ranch includes several dams and water troughs, one water tank and 2 cattle dips. It also has a number of permanent springs and rivers for watering cattle and maintaining pasture year-round. Sumbawanga Agricultural and Animal Feeds Industry (SAAFI) is the primary local processor with a modern abattoir. Beef is sold domestically in Mbeya, Rukwa and Katavi at mining facilities, hotels, factories and supermarkets. Primary opportunities for export are to the countries on Tanzania's Western border (Zambia, Malawi and the Democratic Republic of Congo). Transportation of beef to other regions is available by train along the central railroad, and eventually by air once the Mbalizi International Airport in Mbeya Region is completed. Like the other ranches in the Corridor, Kalambo Ranch sources immature cattle from neighboring districts (Sumbawanga, Nkasi, Chunya, Mpanda and Mbozi) for fattening.

Potential opportunities for improved meat slaughtering facilities

NARCO is also investing in livestock marketing infrastructure that will purchase cattle from small-scale livestock farmers. NARCO aims to contribute to the livestock sector through the establishment of modern meat slaughtering and handling facilities and infrastructure, including the establishment of a hygienic abattoir and integrated rendering facilities. These products will be geared towards export markets that will both improve quality and increase quantities while meeting international standards.

The Government, in collaboration with the private sector, is currently supporting the construction of new abattoirs with a processing capacity of 150 -200 animals per day. Yet this investment alone will be unable to meet the demand for processed meat in the domestic and international markets. The Ruvu Abattoir is one possible "quick win" opportunity for joint ventures to meet the remaining market demand. Located about 70 km North-west of Dar es Salaam City along the Dar es Salaam – Morogoro highway, this abattoir is under NARCO's management. Both the neighboring Ruvu Ranch and Kwala Holding Ground could supply the abattoir. The establishment has an area of about 2,000 ha which could be renovated to support some feedlot production on site. At its current capacity, the facility can slaughter 400 cattle in each 8 hour work shift. The abattoir also has reliable water and electricity to support its operations. Livestock for the abattoir could be sourced from the following areas: Ruvu Ranch, Pugu Livestock Market, Bagamoyo, Morogoro, Dodoma, Handeni and Korogwe. The Ruvu Abattoir supplies beef and mutton to domestic markets, including mining centres, hotels, supermarkets and select markets in Dar es Salaam, as well as export markets in the Gulf states, and countries throughout East Africa.

Additional supporting activities

Since there are few examples of sustainable and efficient commercial beef production in the Corridor, investment in research and monitoring will be important to test and evaluate specific improved management practices in Corridor, such as rotational grazing, holistic grazing management, silvopastoralism, and biogas digesters. Over time, this knowledge base can be used to support the

dissemination of best practices and management options for livestock producers in different parts of the Corridor.

Knowledge sharing and industry collaboration for sustainable intensification of beef production may also help develop the opportunities for economic gains (See Box C4-2).

Box B4-2. The business case for sustainable beef: an example from Brazil

The Brazilian Sustainable Beef Working Group was founded in 2007 in an effort to improve the sector's profitability by addressing the serious challenges faced by the livestock sector in managing degraded lands and complying with recent social and environmental policies adopted by producers, industry and retailers. The Working Group includes a wide spectrum of representatives of industries and industry organizations, associations of farmers, retailers, banks, civil society organizations, research centers and universities. The steering committee includes civil society institutions such as WWF Brazil; Financial institutions include Rabobank Brazil and IFC; commerce and service groups including Dow AgroSciences and Walmart; and industry institutions such as Abiec, or the Brazilian Association of Meat Export Industries. The Working Group members established one central commitment to "no-deforestation, with the creation of conditions and ways of compensation to make it viable." This central commitment is achieved by monitoring deforestation, defining the social and environmental principles for production and trade, developing a traceability mechanism and disseminating best practices that will help recover degraded lands and reduce socio-environmental liabilities. Mutual commitment to the principles set by the Working Group protects the profitability of the beef sector by guaranteeing that the sector is able to meet domestic and international policy requirements for beef production as well as public policies regarding environmental degradation. The economic incentive task force works within this framework to develop mechanisms that provide incentives for sustainable livestock management, such as improved credit management for sustainable ranches, establishment of payments for environmental services schemes, and development of new public policies that allow long-term financing for sustainable cattle farming that is differentiated from conventional cattle farming finance. In order to be successful, actors along the entire value-chain must be committed to transparent and active participation in the establishment and implementation of the principles of sustainable cattle ranching.

SAGCOT Agriculture Green Growth: Opportunity Analysis #5
An Enterprise Approach to Community Forestry

WHAT ARE COMMUNITY FOREST AND AGROFOREST ENTERPRISES?

Commercialization of tree products from farms and community managed forests can provide important sources of cash income for farming households and communities, and diversify economic development. By adding economic value to forest resources, forest and agroforest enterprises increase incentives for forest conservation and restoration, sustain the benefits from forests for local subsistence (foods, medicines, feed, raw materials, fuel , building materials), as well as for ecosystem services and biodiversity, and climate benefits. Forest enterprise development can be an important component of strategies for landscape restoration, forest protection (including REDD+) and agricultural intensification.

Already burgeoning commercial demand for forest products in the SAGCOT region will be accelerated by planned agricultural and infrastructure investments and income growth. This demand could either threaten the region's rich forest resources, or become a positive driver of economic growth and poverty reduction if farmer and community forest enterprises can be scaled up. Agricultural Green Growth in SAGCOT can enable coordinated investment in crops, livestock and forest resources, by promoting extension systems, credit, enterprise training, etc, that include the full range of land-based commercial enterprises in the Corridor.

Forest and tree crop industry companies and investors can partner with farmer and community forest organizations, as outgrowers, contract producers, joint investors, or other business arrangements, with support from other government and civil society actors.

EXPERIENCE WITH COMMUNITY FOREST ENTERPRISES

The potential of community forest enterprises has been systematically promoted only in the past few decades; the previous focus was on large-scale private forest concessions and government management and sales from public forests. In fact, small and medium sized enterprises (SME) dominate the forest industry worldwide, accounting for 50% of wood harvested in the European Union and United States, and 95% of the forest industry in Brazil and India. As rights to own and manage forests have reverted increasingly to communities, and potentials for growing trees on farms have been recognized, CFE investments are growing rapidly (see Box 1).

Current activity in Tanzania

In Tanzania, apart from traditional commercial smallholder coffee and coconut, and some minor exports, most of the smallholder and community forestry enterprises are for local and informal national markets. Participatory forest management (PFM) was introduced into Tanzanian law with the passing of the Forest Act in 2002. This act provides a clear legal basis for communities across Tanzania to own, manage or co-manage forests under a wide range of conditions. The law recognizes two types of PFM: (i) Community Based Forest Management (CBFM) which allows communities to declare and gazette village, group or private reserves; (ii) Joint Forest Management (JFM) that allows communities to enter into co-management agreements with government and other forest owners and share commercial benefits. By 2007, 719 communities were engaged in CBFM and 209 Forest Reserves were under Joint Forest Management arrangements covering a total of 1.61 million hectares. As communities have become aware of the true commercial value of timber on their lands there are positive signs that they have begun to defend their own forest resources (rather than collude with illegal extraction as in the past) (MacQueen 2010).

In the SULEDO Forests of Kiteto District, nine communities own and manage a 167,400 ha Village Land Forest Reserve through an apex body known as the Zonal Environmental Committee (ZEC). They have been among the first in Tanzania to develop a sustainable harvesting plan (with a 60-year rotation) for valuable timber species such as Dalbergia melanoxylon (MacQueen 2010). There are many market enterprises in the agroforestry systems around Kilimanjaro. In Shinyanga, farmers earnings vary widely from products sold locally from community-managed forests. Households producing for HoneyCare (which also operates in Kenya, Uganda and the Sudan) earn $1800-2500/year. The Novella Partnership backed by Unilever in Tanzania, Ghana and Nigeria, is actively promoting commercialization of indigenous Allanblackia, with support from IUCN-Tanzania (Buss, et al 2011).

Current activity in SAGCOT

A number of community forestry development projects are underway in the SAGCOT region. One of the most notable is TAGRODE, which is building the supply base of higher-value forest products and community capacity to establish and manage them, mainly in Iringa District, located within SAGCOT's Ihemi Cluster. Presently the organization is focusing in three villages to promote planting of agroforestry trees on farms for soil fertility improvement and commercial harvesting. TAGRODE also enhances the capacity of community and village leaders to engage in participatory forest management. Beyond their afforestation activities, the organization is beginning participatory programs for protecting, monitoring and managing natural forest boundaries and water catchments. Already 225,000 trees of a variety of species have been planted on farms, while 1.5 million agroforestry trees have been raised in nurseries to supply farms and commercial forestry plantations. There has been an increase in the planting and survival of indigenous multipurpose trees, especially Uapaca kirkiana (Mkusu in Swahili) and Vangueria infausta.

Project activities in the ELCT Iringa Diocese were initiated in 2010 to reduce deforestation and improve the living standards of people surrounding the Diocese through planting trees for income generation and natural regeneration of existing forest. The communities are located in Kilolo, Iringa Rural, and Mufindi Districts. Project objectives are to plant one million trees within the Iringa Diocese by the year 2015, and to train and sensitize 50,000 people around Iringa Diocese on the importance of forest conservation The annual budget is 12 million TZSH (USD 8,000), and local people help finance 20% of the cost the project through Iringa Diocese.

There is a close link with agriculture. The Kikombwe Sustainable Agricultural Project (KISADEP) and Mlolo Sustainable Integrated Project (MSIPRO), funded by Gorta-Ireland, promotes conservation farming through agroforestry in Mlolo division. The practices of conservation farming with trees include disturbing the soil as little as possible, and keeping the soil covered with organic material to replenish soil nutrients. The farmers are trained on Integrated Pest Management (IPM) and the efficient use of inorganic fertilizers, as well as sustainable land use and forest management and community rights to manage their own forests as stipulated in the forest act of 2002. Working with WWF-Tanzania (and EnterpriseWorks?), TAGRODE works with the Iringa District Council and the Kilombwe, Malagosi and Lyamugungwe villages, to enhance the skills and capacities of communities and village leaders.

In 2010-11 the community managed to distribute and plant 205,000 Pine (Saligna) seedlings and 25,000 Eucalyptus seedlings. Three schools in the area have planted over 2,500 trees in their compounds, while over 600 households planted over 10,000 trees. TAGRODE-supported activities have significantly enhanced the forest resource base and its commercial value: a halt to burning of the forest, and increased undergrowth that has checked soil erosion; Increase in the amount of natural dead wood that is collected for firewood; Increased natural grass and shrub cover that can be used to graze livestock; Increased availability of wild mushrooms, natural fruits and medicinal shrubs; Increased bee activity, that has led to youth establishing bee-hive making business for apiary; Increased community awareness of a healthier environment due to forestry; and better social cohesion because the community members meet frequently

in various afforestation forums. Product demand is growing rapidly and more organized enterprise development is starting to take advantage of these resources.

Capacity building has included: decision making on village forest boundaries and planting of beacons for the boundaries; policy analysis and advocacy; training for Participatory Forest Assessment Team (PFAT), forestry data collection and analysis, management plans by village council and local authorities, monitoring and evaluation. Villages have been assisted to develop by-laws for management of the adjacent forest, to establish Village Forest Scouts (20 in each village) who protect the forest on voluntary basis, primary school environmental committees, and dvelopment of Ward tree planting plan. The plan has a resolution that each household should plant at least 15 trees, each village council plants 100, and each school plants 100 trees.

POTENTIAL AND BARRIERS FOR SCALING UP COMMUNITY FOREST ENTERPRISES IN SAGCOT

Although the level of investment so far in the commercialization of community based forest and tree resources is modest, promising AGG investments are evident which if scaled up can help to increase product supply, increase farmer and community incomes, and benefit ecosystems, biodiversity and climate. Tree nursery establishment is relatively easy; the current cost of raising, distributing and planting 100,000 tree seedling is TSh 12 million. Providing advisory services for market development, entrepreneurship, business finance, negotiation and forest-agroforestry management can be linked to SAGCOT extension and business development investments. Table 1 illustrates the potential scale of supply and income impacts from accelerated development building on the existing TAGRODE base in Ihemi Cluster. TAGRODE is interested to expand activities to other Phase 1 SAGCOT Clusters.

Barriers to scaling up

TAGRODE identified the following constraints to scaling: 1) inadequate community awareness of the importance of tree planting in relation to climate change, 2) lack of relevant knowledge on soil properties for informed decisions on the right trees for planting, 3) inadequate tree seedlings to distribute to as many people and institutions as might like them, 4) lack of security to protect the planted tree seedlings from grazing and trampling by cattle, 5) insufficient funds in villages for tree nursery establishment, 6) lack of sufficient fruit trees for distribution, and 7) poor quality seeds and other germplasm. In addition, farmers and community forest management groups have limited knowledge of income generation through forestry, so that social organizations need to become viable business entities, and develop competitive business capacity.

Farmers and communities would value collaboration with socially and environmentally responsible forest product companies to improve commercial quality and business management. Pilot investments can help to identify appropriate business arrangements and provide financing to cover critical costs. Guidelines have been developed for African economic contexts to facilitate profitable and equitable deals and partnerships (Buss, et al 2011). Successful outgrower models, already in place in parts of Africa, could include:

1) wood-processing companies obtain their supplies through trading intermediaries who buy from growers;
2) wood-processing companies lease land under contract for a specific period from landholders to grow the trees themselves;
3) wood-proceessing companies enter into a contract with farmers to grow trees that are then sold to the companies;
4) cropshare joint ventures in which contract agreements between landowners and a wood processing company (investor) specify the responsibilities of each partner and sharing of costs

and benefits throughout the life of the tree crop; returns from the harvest are determined by the market price;

5) guaranteed tree ventures in which a wood processor guarantees the sale of trees/wood for the tree grower based on a specified market price. In return, the grower offers the processing company partner the first option to purchase the trees/wood with provision that the grower may sell to another purchaser who offers a better price (Mayers and Vermeulen 2002).

SAGCOT Agriculture Green Growth Opportunity Analysis #6
Differentiated Markets for Sustainable Agriculture

WHAT ARE DIFFERENTIATED MARKETS FOR SUSTAINABLE AGRICULTURE?

Many farmers and food processors in the Southern Agricultural Growth Corridor of Tanzania (SAGCOT) adhere to high standards for food product quality, environmental management, and social benefit. But to be able to benefit financially from these practices, producers need a way to distinguish their superior products in the marketplace. Differentiated markets can help them do so by linking buyers who seek a steady supply of high-quality products with producers who are able to meet this demand by complying with specific production and processing standards.

Producers may differentiate their products by adhering to standards for food quality, environmental performance, and/or social performance, such as:

- Organic production standards
- Agricultural product standards imposed by importing countries for internationally traded goods (e.g., Good Agricultural Practices or GAP standards)
- Requirements of regional or national exporting bodies
- Private sector standards, such as sourcing guidelines of international food companies
- Third-party eco-standards, such as Fairtrade, Rainforest Alliance, or Forest Stewardship Council certification

Compliance with such standards can offer a significant business opportunity for SAGCOT producers by: 1) enabling them to receive price premiums for their products; 2) increasing access to foreign markets or niche markets; and 3) ensuring more stable or guaranteed demand for their products. But adherence to agricultural production and processing standards may also be costly and complicated. These barriers can be especially challenging for small-scale producers.

This Agriculture Green Growth (AGG) opportunity analysis evaluates existing differentiated agricultural value chains and institutions in the SAGCOT region. It then identifies changes that could allow SAGCOT farmers—especially smallholders—to participate more fully in differentiated markets to increase the productivity, profitability, and sustainability of agriculture in the corridor.

POTENTIAL BENEFITS OF THIS AGG OPPORTUNITY

In addition to their marketing and price-premium benefits, agricultural standards may also help farmers adopt practices that are more sustainable, use inputs more efficiently, and are more resilient to drought and climate change. Across Africa, 93% of certified organic producers report improved soil fertility, water supply, flood control and on-farm biodiversity. Whereas many small-scale African farmers have historically managed their land organically by default (i.e., because they could not afford to purchase chemical inputs), the adoption of production standards can help increase yield and efficiency through more systematic management. For instance, strategic use of green manure, cover crops, integrated nutrient management, and application of locally available organic inputs can improve soil fertility, reduce erosion, and conserve soil moisture. Adoption of good agricultural practices (GAP) and good manufacturing practices (GMP) required for organic certification can significantly increase productivity.

For large-scale producers and associations of small-scale producers, participation in differentiated markets through certification often provides the opportunity to access shorter value-chains, resulting in a greater percentage of product revenues being received by producers themselves. Certification

requirements may also require upgrading the value chain infrastructure of processing and distribution. This requires up-front investment but returns dividends through higher quality and more valuable products.

CURRENT EXPERIENCE IN SAGCOT AND BEYOND

The global market for organic products has grown rapidly over the past several years, increasing from US$18 billion in 2000 to US$55 billion in 2009. Meanwhile, major agri-food companies are moving toward "supply chain-wide" adoption of sustainable sourcing standards. For instance, 30% of Unilever's agricultural raw materials already adhere to a broad set of social and environmental sustainability standards, and this figure is planned to increase to 100% by 2020. There has also been exponential growth in the adoption of third party sustainability standards, thereby shifting sustainably certified products from a small market niche to a mainstream force in international agribusiness. For instance, the volume of Rainforest Alliance certified tea has grown from a minimal amount in 2007 to more than 250,000 tons (6.6% of the total world market) in 2011. These trends indicate that sustainability standards and differentiated markets should be a central part of any forward-looking strategy for SAGCOT.

In Tanzania, there are nearly 90,000 certified organic producers, managing about 62,000 hectares, or 0.2% of the country's agricultural land. Organic production in Tanzania increased more than five-fold from 2001 to 2009. Yet, the sector remains relatively small compared to neighboring countries such as Uganda, which has nearly 300,000 ha of certified organic agriculture. More than 90% of Tanzania's certified organic products are exported, while the remaining portion are consumed primarily by expatriate, not Tanzanian, consumers. The largest organic value chains are for cocoa, cashews, vanilla, tea, and coffee (Table C6-1). Domestic organic value chains are focused on fresh fruits and juice, vegetables, tea, and instant coffee. There are only two organic food processors in the country: Dubaga in Iringa and Chemi in Dar es Salaam. Packers and processors are reportedly requesting greater organic production from producers. Given global demand trends relative to existing sector development, there is significant potential for increased organic sector development throughout SAGCOT.

Table B6-1. Tanzania organic agricultural product exports, 2009.

Product	Metric tons	Farm gate price (Euro/kg)	Total value (farm gate) (Euro)
Cocoa	3,822	0.95	3,630,900
Cashews	2,671	0.95	2,537,450
Coffee	590	1.00	590,000
Tea	500	2.10	1,050,000
Spices:	400		
-Pepper	160	0.48	76,800
-Lemon grass	120	0.08	9,600
-Cardamom	60	0.80	53,400
-Cloves	50	2.10	105,000
-Cinnamon	10	1.47	14,700
Sesame	273	0.94	256,620
Pineapple	196	0.12	23,520
Cotton	151	0.47	70,970
Vanilla	74	20.00	1,480,000
Total			**9,898,960**

Source: TOAM and field data Kledal 2009

The SAGCOT region has more than 35,000 hectares of high-value horticulture, coffee, tea, cocoa, and other crops currently under organic production, engaging more than 41,000 farmers, mostly through outgrower schemes (Table C6-2). Other sustainability standards are also in use. In Kyela district, for

instance, more than 20,000 cocoa farmers received Rainforest Alliance certification in 2011 to enable them to sell certified cocoa to Dagoba Organic Chocolate (a brand owned by The Hershey Company). As one of Rainforest Alliance's largest-ever group certifications, the scheme enabled small-scale farmers to benefit from more stable market access and prices, without the need to bear the high costs of individual certification. Unilever has also obtained Rainforest Alliance certification on portions of its 20,000 ha of tea estates in Mufindi district. For instance, on the 4,000 ha Lugoda estate, the major portion of the property is dedicated to forests, wetlands, and grassland, which conserve biodiversity, protect critical water supplies, and provide a woodfuel resource for the farm. The estate also works with local communities to conserve forests through tree planting, education, and an efficient cookstove project. Rainforest Alliance certification enables Unilever to benefit from these sustainability credentials by differentiating its product in the marketplace.

Table B6-2. Organic production in the SAGCOT region, 2009.

District	No. of enterprises and supply organizations*	Major products	Hectares	Outgrowers / farm members**
Morogoro	3	Fruit, spices, cocoa	1,362	1,198 / 25
Pwani	5			
Iringa	2	Pineapple, tea, cotton, sesame	9,600	3,300 /
Singida	1			
Mbeya	4	Cocoa, coffee, vegetables	24,655	36,979 / 63

Source: TOAM and field data Kledal 2009

*Includes some enterprises that are not yet certified

**Farm members are part of a farm association of a cooperative

Certification institutions and capacity

In 2003, TanCert was established as a national certification body for organics. TanCert works closely with the Tanzania Organic Agriculture Movement (TOAM), which organizers producers, processors and exporters to facilitate organic sector development for domestic and international markets. A major milestone was the launch of the East African Organic Products Standard (EAOPS) in 2006, along with its own label in 2007. In 2008, TanCert received accreditation from the International Federation of Organic Agriculture Movements (IFOAM), which allowed locally certified products to be recognized as certified organic by importing countries. Establishment of regional standards and a national certification body have improved the credibility of Tanzania's organic sector in global markets while significantly reducing certification costs for producers.

Following the establishment of EAOPS, the Ministry of Agriculture, Food Security and Cooperatives is working alongside TOAM, exporters, and producers to implement the National Organic Agriculture Development Programme (NOADP). This programme aims to set clear policy goals for developing the organic sector through 2015. With the initiation of a supportive national policy framework, combined with the organic sector's high rate of growth, the door is open for new investments in the organic agriculture sector.

SCALING UP DIFFERENTIATED AGRICULTURAL MARKETS FOR SAGCOT

Given the strong demand, there is potential for a significant portion of the 350,000 hectares of new agriculture planned for SAGCOT to be managed under profitable, sustainable production through certified or differentiated value chains. This section identifies the most promising opportunities for scaling-up certified agricultural production and differentiated markets for sustainable products. It also highlights several barriers that appear to be inhibiting the development of the certified market segment.

Promising opportunities

There are significant opportunities for increasing certified sustainable production in several sectors including fruit, horticulture, tea and coffee, floriculture, spices, and even basic grains. Many of these opportunities would align well with the cluster development model proposed for SAGCOT wherein investments are spatially coordinated to integrate production, processing, distribution, and knowledge/extension services in target areas, linking smallholder and commercial operators.

Fruit and horticulture for export: Of the six regions in most suitable for horticultural production in Tanzania, three are in the corridor (Morogoro, Iringa, and Mbeya). Major vegetable crops in these regions include tomato, cabbage, onion and carrot. Even in cases where producers cannot meet organic production standards, other certifications for good agricultural practices (GAP) can give producers access to high-value European markets. Following such practices can increase both revenues and yields. For instance, in one case, GlobalGAP certified producers of baby corn, green beans, and peas increased yields 10-32%, while increasing per-kg revenues by 10-24% relative to un-certified producers. Because horticulture crops tend to yield high per-hectare gross revenues relative to staple grain crops, they may be a particularly efficient focus for new irrigation schemes. However, irrigation infrastructure for the horticulture sector in SAGCOT is currently minimal. Additional barriers to development of this sector include very limited processing and transport infrastructure.

Horticulture enterprises are well suited to smallholder participation through outgrower schemes, and also offer abundant employment opportunities. Smallholders may also be able to participate readily in certified fruit markets, provided that processing infrastructure is available nearby, as suggested by the following case.

Box B6-1. Getting to Scale: Integrating Smallholders into Organic Fruit Value Chains with EPOPA

The Dabaga Fruit and Vegetable Canning Company has been operating near Njombe, Iringa region since 1979, producing processed fruit and vegetable products from smallholder suppliers. The company started by processing tomatoes, one of the most profitable and abundant high-value crops in the Iringa region. In 2005, Dabaga joined the EPOPA (Export Promotion of Organic Products from Africa) project to begin offering organic pineapple products certified by HACCP and Naturland. First introduced to the Iringa region in 1976, pineapple is now raised by 50% of all families in the region. Due to a lack of access to chemical fertilizers and pesticides, many smallholders were practicing organic pineapple production by default. Through EPOPA, farmers receive extension and training services in improved organic production techniques, which has increased yield to up to 10 tons per acre. Organic pineapple products sell at prices 260% higher than non-certified pineapple. Following the project's inception, smallholder incomes increased and product quality improved. Also, now that Dabaga is a certified organic processor, the company can add new organic products with reduced upgrading costs.

Differentiated tea, coffee, and cocoa: As discussed above, certification of major export crops such as tea, coffee, and cocoa can help improve livelihoods for smallholder producers while providing incentives and technical assistance for support more sustainable, biodiversity-friendly production practices. Increased use of certification may be supported by investments by producers' associations (accessing various sources of small enterprise finance), development projects, and/or companies seeking to purchase certified products. The case example from Kericho, Kenya, describes the latter approach, and some of the benefits that have resulted for local people and the environment.

Smallholder staple crops: In developing countries, market differentiation of staple grains tends to be more difficult than for fruits, vegetables, and specialty products, but it is not impossible. Certified sustainable labels for domestic and regional markets have been established successfully in several developing countries. In Zambia, for instance, the "Its Wild" label distinguishes food products grown

according to organic, wildlife-friendly production standards—including whole ground nuts, peanut butter, honey, chama rice, dried beans, and maize meal. A similar approach could be applied in SAGCOT.

Box B6-2. A Triple-Win: Certified Tea for Unilever in Kericho, Kenya

Since 1999, the Unilever Corporation, a Europe-based international conglomerate, has been executing a pilot program on its tea estates in Kericho, Kenya, to continuously improve environmental management and productivity over the farms' total 13,000 hectares. Tea is planted using mulch and intercrops, which help increase levels of soil organic matter, while bunds (embankments), micro-catchments and drainage systems enhance soil and water conservation. No insecticides, acaricides (pesticides that kill mites), or fungicides are used in the tea fields. The program has also addressed the estate's energy needs by planting fuelwood, which is used for drying the tea, and by developing a hydro-electric facility to provide most of the company's electricity.

The plantations are managed as ecological landscapes providing clean water and habitat in addition to tea. Dispersed throughout the tea fields are patches of forests, small wetlands, and windbreaks consisting of eucalyptus and grevillea trees. Riparian forests make up over 10% of the estate, extending at least 30 meters from all water bodies. By conserving indigenous trees and shrubs, the program seeks to enhance the conservation and social value of forest remnants. The program also acts as an educational resource for nearby communities and helps build capacity of local workers, for instance through courses on the management of indigenous tree nurseries.

Recently, Unilever expanded the scope of its sustainable agriculture program with a decision to pursue certification from Rainforest Alliance, a process that required greater protection of wildlife, natural habitat, workers' rights, and benefits for local communities. Rainforest Alliance certification requires that workers earn fair wages (typically about three times the local agricultural minimum wage) and be provided with access to adequate housing, education and healthcare. These benefits extend to the estate's 16,000 employees and their 65,000 dependents. Unilever admits that it will take time to recoup up-front investment in implementing the new standards. But in the long-run, these changes are expected to give a strategic edge to Unilever tea brands such as Lipton, PG Tips, and Lyons. Investment in productive soils, clean water, and supportive local communities will also bring long-term benefits.

The program is part of two broader initiatives to mainstream sustainable agriculture within major international agri-food companies. For Unilever, it is part of a commitment to source 100% of agricultural raw materials sustainably by 2020. Unilever's Sustainable Agriculture Code defines parameters for sustainability in relation to soils, water, biodiversity, agrochemicals, energy, waste, and other categories. The program also relates to the Sustainable Agriculture Initiative (SAI) Platform, a food industry initiative mainstream sustainable agriculture through the food value chain. Unilever was a founding member of the SAI Platform, along with Nestlé and Danone. The SAI Platform also has developed guidelines related to farming systems, and social, environmental, and economic performance, to assist member food companies and their suppliers in transitioning to sustainable, profitable production systems.

Sourcing standards and guidelines such as those put forth by Unilever and the SAI Platform point to a future in which the most competitive producers will be those that incorporate sustainability into their core business model. The Kericho example suggests how these guidelines may be implemented in practice to benefit local communities and the environment.

Smallholder spices: Although spices are not a major commodity group in the region, organic spice value chains may be easier for smallholders to access. The challenges of poor infrastructure affecting processing and transportation have less effect on this value chain, as farmers can often dry and processes species locally and enter a shorter post-harvest value chain. Converting to organic production is rarely difficult as most spices are naturally pest-repellant and can be grown easily in intercropped or mixed cropping systems.

Floriculture: The floriculture sector is currently undeveloped in SAGCOT, although parts of Mbeya, Iringa and Morogoro regions are considered high potential areas for investment in floriculture. While

Kenya leads East Africa by far in floriculture production, demand for floriculture products, and now particularly organic floriculture products, from Europe remains high. Floriculture businesses in the Lake Naivasha region have successfully upgraded their practices and facilities to be environmentally sustainable and attractive to specialty markets. Developing the floriculture sector in SAGCOT would present many of the same challenges as high value fruit and vegetable production, with the additional challenge of the lack of local leading enterprises. However, this space could be open to foreign investors or to domestic investors from Arusha, where floriculture is already well established.

The newly constructed Songwe Airport in Mbeya presents an opportunity to stimulate export of high-value and certified products from the corridor, particularly for horitculture and floriculture. However, investments in packing and shipping facilities must be paired with government investments in transportation infrastructure for moving products from the center of the corridor to the new airport. With respect to both horticulture and floriculture, as a newly developing sectors in SAGCOT these industries and their investors should be encouraged to "leapfrog" conventional production methods to gain the benefits of improved market access, price premiums, and reduce environmental impact associated with certified sustainable or organic production.

Key challenges and barriers

Some of the above opportunities appear ripe for implementation, but await interested investors. In other cases, there are important structural limitations. The following key barriers and limitations will need to be overcome to scale-up opportunities for producers to participate in profitable differentiated value chains.

Transport and distribution: For organic or other certified vegetable and fruit production, transportation from remote regions presents a significant barrier. There are few certified processors in the region and the only certified exporters for the corridor are found in Dar es Salaam. Some products can be processed or dried on farms; however, individual farmers usually lack the capacity or capital to upgrade their facilities to the standards demanded by certifying bodies. In Kenya and Zambia, a similar situation has resulted in the exclusion of smallholders from organic fresh fruit and vegetable value chains driven by large supermarkets and urban consumers. In the center of the corridor, the focus should be on developing new processing facilities for highly perishable or fragile produce that cannot be transported raw.

Cost of certification: In the past, organic certification has been a time-intensive and expensive process. International third-party certification is often so expensive that only large-scale farmers can afford it. Furthermore, to participate in international markets, producers may be required to meet multiple sets of standards, and this burden shows signs of growing as importing countries place more stringent requirements on producers. In this context, national and regional coordinating entities can be helpful for developing harmonized local interpretations of various international standards. For instance, TanCert serves as an intermediary between Tanzania's organic producers and international standard-setters. The group recently participated in the development of regional standards that should give East African countries the chance to vie for more flexible and regionally appropriate applications of international standards. Similar efforts can continue to make certified value chains more accessible to producers.

A related need is to ensure that accredited certification bodies and audit/verification services are accessible to farmers throughout the corridor. This may require additional support for certification bodies, for instance to establish regional offices and ensure adequate staff capacity to meet growing demand.

Extension and research support: To date there has been little extension and research for organic agriculture and other "certification-ready" farming systems in the corridor. One apparent reason is that organic (or low external input) and conventional systems have been viewed as competing approaches to agriculture. Extension support for meeting the specifications of particular certification standards may be

beyond the purview of most government or local NGO extension workers, and will require additional investment or specialized training to enable extension workers to provide this support.

Investment in export-oriented aggregators and processing facilities: Existing successful examples from the corridor and elsewhere indicate that a certified processing facility or aggregator can serve as a nucleus to catalyze sustainable, profitable production for thousands of small-scale farmers. Such investment could come from international companies, from exporters, or from producer associations that are able to secure stable sales contracts with foreign buyers. As yet there is little competition among exporters in Tanzania, and foreign exporters currently dominate certified export value chains. There is a strong need to establish new processing facilities or upgrade current facilities to meet the standards required to export to Europe and North America, including for certified sustainable or organic products. Additional investment in wholesale businesses that establish strong relationships with domestic and international grocers and agri-food companies to supply certified sustainable high-value commodities and niche market products can help spark local demand for producers to obtain certification and reap its benefits.

SAGCOT Agriculture Green Growth Opportunity Analysis #7
Building a Tanzania-Led AGG Finance Pipeline

[*This Opportunity Analysis will be provided in the Final Report.]*

SAGCOT Agriculture Green Growth Opportunity Analysis #8
Payments for Ecosystem Services

[*This Opportunity Analysis will be provided in the Final Report.*
Summary material on payment for ecosystem services in provided in Chapter 4.]

Annex C: Existing Conditions

A clear understanding of current agricultural and environmental conditions and issues in the Southern Corridor is critical for informing a well-founded AGG strategy. This Annex provides supporting material related to existing conditions, trends, constraints, and opportunities in the Corridor. The information is based document review, expert consultations and field observations of the AGG team, and input of workshop participants. Further information on many of the topics discussed here is available from other recent studies and reports, the most important of which are identified and briefly summarized in Annex E.

This Annex covers the following eight topics. The first five topics are discussed at a Corridor-wide level. The last three provide more detailed summaries of existing conditions in each of the three priority (Phase One) clusters.

- Land use
- Agriculture and agricultural suitability
- Water
- Biodiversity, forests, and protected areas
- Climate change
- Key Features, Trends, and Challenges in Kilombero Cluster
- Key Features, Trends, and Challenges in Ihemi Cluster
- Key Features, Trends, and Challenges in Mbarali Cluster

Land Use

Aside from several large protected areas, land use in most of the Southern Corridor is quite heterogeneous, consisting of mosaics of forest, woodland, shrubland, grassland, and cropland. Only a small fraction of the Corridor's cropland land is in large, permanent estates; most agriculture is interspersed with other land uses, or in a pattern of shifting cultivation. On the other hand, much of the apparently unoccupied natural land outside of protected areas (and to a lesser extent within protected areas) is in fact used for periodic grazing, cropping, hunting, and gathering of wild products. See Table C-1 for a summary of land cover within the Corridor.

Table C-1: land cover in the Southern Corridor, as of 2009. Source: ESA Globcover data (2009), classified and analyzed by the AGG team.

Land Cover	Area (sq. km.)	Percent of Total Land
Urban and other artificial areas	447.9	0.1%
Croplands (crops occupy ≥70% of area)	10,134.5	3.3%
Mosaic croplands (crops occupy <70% of area)	71,544.8	23.3%
Evergreen forest	12,841.0	4.2%
Deciduous forest	71,234.7	23.2%
Woodland	57,826.6	18.8%
Shrubland	37,891.7	12.3%
Grassland	31,111.2	10.1%
Wetland	4,316.9	1.4%
Water bodies	10,107.3	3.3%
Total land area	**307,456.6**	**100.0%**

Agriculture and Agricultural Suitability

Agriculture is a primary driver of the Tanzanian economy, accounting for 50% of GDP and employing 80% of the population nationwide and up to 90% in rural areas. The Southern Corridor covers several agricultural strongholds including at least parts of the "Big Four" agricultural regions (Iringa, Mbeya, Rukwa and Ruvuma) which regularly produce a surplus of maize and include two of the nation's most productive wetlands for paddy rice – the Usangu plains and the Kilombero floodplain. Besides these two staples, the Corridor produces large quantities of sugar cane, most of the country's potatoes, and significant amounts of groundnuts, tomatoes, onions, pyrethrum and tobacco. Coffee and tea also are grown in highland regions.

Irrigation schemes, which will be discussed in more detail later, are an important component of farming systems in some parts of the Corridor, particularly around the Usangu and Kilombero floodplains where river water is easily diverted to supply irrigation to fields. Paddy is by far the most commonly irrigated crop, although sugarcane is also cultivated under irrigation in some basins including the Kilombero Valley. Generally, yields for irrigated crops are much higher as the crop is able to meet the water requirement for growth and, in most cases, farmers are able to plant a dry season crop.

Over the past several decades the national budget for agriculture had declined. However, in the past few years, the international community and the Tanzanian government have expressed renewed interest in strengthening the country's agricultural sector. This renewed interest is probably sparked by a number of factors including a growing demand for food, a realization that Tanzania's area of potentially arable land could support enough agriculture to make the country a regional exporter, and investments in seeds, fertilizers, pesticides and irrigation systems that might be able to close the yield gap in regional staple crops. The government's strategy, Kilimo Kwanza (Agriculture First), outlines its plan to prioritize agriculture. This is manifest by new sources of governmental financial and technical support, as well as the government's commitment to seek new partnerships and investor to help build the sector.

One of the biggest challenges to boosting the sector's performance is guaranteeing information and technology transfer down to smallholders who compose the majority of Tanzanian producers. Since the 1990s, the country has sought to develop the sector through the Agricultural Sector Development Plan (ASDP), a basket fund program established between the government of Tanzania, IFAD and other international donors to set national priorities for sector development. Since district and community level participation in the ASDP is seen as an integral part of poverty reduction, the national priorities are tailored to local contexts via district-level plans (DASDPs) that include plans for training and extension, land use planning, expansion of rural finance and market opportunities, and strengthening of local government and community management and monitoring. The DASDPs also seek to build the social infrastructure and support livelihoods through programs focused on gender equality and HIV/AIDS and malaria prevention, all of which affect production through effects on the rural workforce. Investments in infrastructure in DASDPs often focus on updating and improving irrigation systems and roads, while the financial component often focuses on strengthening savings and credit institutions and improving market linkages. Extension activities through district plans tend to take place in farmer field schools or other bottom-up capacity building approaches, which are perceived as more effective for achieving adoption and conveying information-rich technologies and management systems.

Water

The majority of land in the Southern Corridor falls within the Ruaha/Rufiji river basin, the largest basin in Tanzania. The basin contains three main sub-catchments: the Great Ruaha, the Kilombero, and the Luwego. The basin also includes three large wetlands—the Kilombero Floodplain, the Usangu flats and

the Rufiji delta—all of which are very important for agriculture. The Usangu flats alone account for 20% of Tanzania's rice production, while the Rufiji river delta feeds the largest mangrove forest in East Africa.

Other river basins in the Southern Corridor include the Wami/Ruvu basin in the northeastern portion of the Corridor, which encompasses the coastal plain around Dar es Salaam and the mountains to the west. The Lake Rukwa basin, in the far western part of the Corridor, is fed by streams that often dry up during the dry season. The shallow Lake Rukwa, which varies in physical and chemical composition throughout the year, is an important source of water during the dry season. The Lake Nyasa basin covers the southwestern portion of the Corridor.

The primary management concerns in the Rufiji basin are restoring year round flow in some cases and in others, managing water demands during the dry season to ensure that there is adequate supply to agriculture, hydropower and several protected areas which attract tourists and provide critical ecosystem services. Irrigation is the most important consumptive water use in the Rufiji basin, accounting for 7.5 million cubic meters per day in 2006. The long dry season and increasing seasonal variability contribute to competition for water resources between the agriculture and hydropower sectors during some periods of the year. The main crops requiring irrigation are paddy rice and sugarcane. The Rufiji Basin Development Authority (RUBADA) has identified more than 600,000 hectares as potential areas for irrigation throughout the basin, with more than half of the area coming from the Kilombero River Valley.

A key objective both for enabling the expansion of irrigation and reducing water conflict is to improve irrigation efficiency (see Table C-2). Many existing irrigation schemes need to be updated to conserve water. Although conditions vary throughout the corridor, dry season abstraction is resulting in many streams drying completely for a part of the year. In addition, spatial and temporal variation in rainfall is increasing, apparently due to climate change. Therefore, the challenge is not only to manage water allocation to an increasing number of users, but also to capture, store and protect water resources to mitigate seasonal variation. Also, improved water efficiency for agriculture leaves more water for hydropower, another important water use in the region.

Table C-2: Irrigation efficiency in different irrigation systems.

Irrigation system	Irrigation efficiency	Installation costs
Flooded fields (e.g. rice)	20-50%	Low
Other surface irrigation	50-60% and higher	Low
Sprinkler irrigation	50-70%	Medium-high
Drip irrigation	80-90%	High

Source: Liniger et al. 2011

More than 80% of Tanzania's hydroelectric power is generated in the Rufiji basin, at three hydro stations (Mtera, Kidatu and Kihansi) that together generate 464 megawatts (MW). An additional hydro station has been long been proposed for Stiegler's Gorge, inside the Selous Game Reserve. First planned in the 1970s, the plant is now being reconsidered as it could generate more than 2,000 MW, control major damaging floods that tend to occur every few years in the lower Rufiji basin, and open up an estimated 460,000 hectares of land for agriculture, including 80,000 hectares which would be suitable for irrigation. While supported by RUBADA, the project remains somewhat controversial because of the potential negative impacts the project could have on the ecosystem and tourism industry related to Selous Game Reserve. An Environmental Impact Assessment (EIA) and updated cost calculations need to be completed before a decision on the project's feasibility can be made.

The Rufiji Basin Water Office (RBWO), established in 1993, is the primary responsible party for managing formal water rights in the basin. Similar water offices have since been established in other basins, however the majority of the nation's river basins (six of nine) which are international, are managed by international basin authorities rather than the national water office. RUBADA is involved in coordinating development activities among the various sectors in the basin. Other bodies, such as the Sustainable Management of the Usangu Wetland and its Catchment (SMUWC) team and now Raising Irrigation Productivity and Releasing Water for Intersectional Needs (RIPARWIN), have been influential in understanding water use for irrigation and impacts on critical wetlands and downstream flows.

Biodiversity, Forests, and Protected Areas

Tanzania covers a wide range of ecosystem types from Miombo woodlands and savannas, to montane forests and mangroves. The Corridor, which includes parts of the Eastern Arc Mountains and the Southern Highlands, as well as some of the most important wetlands in the nation, protects critical biodiversity and supports the growing tourism industry in the Southern Circuit. The ecosystems and forests of the Corridor also provide key ecosystem services to support the health of the country's people and the productivity of its enterprises. Forests and protected areas also perform the important role of maintaining large stocks of terrestrial carbon. New management approaches are attempting to recognize the tight linkages between the many functions of ecosystems and forests, to incorporate local people into resource planning and management, and to develop innovative systems that fairly distribute the benefits generated from ecosystems and their services at various scales.

The Corridor is home to more than 11,000 species of plants, 1,100 species of birds, 360 species of reptiles, 350 species of mammals and 170 species of amphibians. Many of these species are endemic to Tanzania (e.g., more than 15% of plant species and more than 40% of reptile species) and many are threatened or endangered. While the region's biodiversity undoubtedly provides a host of ecosystem services to support residents, the charismatic species, particularly large mammals, found in the region's wetlands and forests are also the primary interest of tourists and game hunters who make an important contribution to the regional economy.

Although the Southern Circuit is not as visited as Tanzania's renowned Northern Circuit, tourism and game hunting have grown steadily over the past few decades. In 1991 Selous Game Reserve attracted 1,150 tourists and 115 hunters and generated US $22,000 and US $1,245,000 in revenue from each group respectively. By 2001 the total number of tourists to Selous had increased to 4,802 and hunters to 482. That year the groups generated US $299,000 and US $3,621,000 respectively. In game reserves hunting generates by far more revenue. However, National Parks, where hunting is not permitted, generate all of their revenue from tourists coming to observe and/or photograph wildlife and biodiversity. The national parks in the Corridor attracted about 8% of all tourists in Tanzania in 2008 (Table C-3). Protecting wildlife and biodiversity could allow these parks to host more visitors and attract a higher percentage of the nation's tourists, generate income that could help fund the management of the national parks and support livelihoods for residents who provide important services to visitors.

Table C-3: Tourism to national parks in the Corridor in 2008.

National Park	Foreign tourists	National Tourists	Total
Katavi National Park	3,161	2,250	5,411
Kitulo National Park	117	413	530
Mikumi National Park	21,038	17,629	38,667
Ruaha National Park	21,832	12,355	34,187
Udzungwa National Park	2,837	1,731	4,568
Corridor total	**48,985**	**34,378**	**83,363**
All Tanzanian National Parks	**685,711**	**397,402**	**1,083,113**

Source: Adapted from Sirima 2010

Protected areas, governance status and management regimes

Protected areas are 27% of the country's land area. When taking into account internationally recognized areas of conservation value, such as Ramsar wetlands and World Heritage sites, this total increases to 46% of the total land area. The 22,000 sq. km of national parks, game reserves and wildlife management areas in the Southern Circuit of Tanzanian protected areas, provide critical habitat much of the previously discussed biodiversity and wildlife. Protected areas fall under one of six governance systems depending on the level of protection offered and the permitted uses of the area. The governance systems, in order of the degree of protection, are: national parks, game reserves, conservation areas, game controlled areas, partial game reserves and forest reserves. Table C-4 displays the area of land under each level of protection.

Of the 13.9 million hectares of formally recognized protected areas, 81.5% are managed by the central government. The remaining 3 million hectares pertain to village reserve areas that are managed through Participatory Forest Management (PFM), a legal arrangement permitted by the Forest Act of 2002 in which communities or groups own and manage or co-manage forests. Tanzania is the strongest example of local involvement in forest management in East Africa, largely due to government decentralization and recognition of local reliance on forest resources. PFM in Tanzania falls into two management classes: Joint Forest Management (JFM), an arrangement in which villagers share management responsibility for lands owned by the central or local government; and Community-Based Forest Management (CBFM), in which local communities assume the cost and co-management responsibility of village or private lands. CBFM is more common, accounting for more than 2 million hectares and is practiced primarily in Miombo and acacia woodlands. JFM accounts for the rest of the land area under PFM and is more commonly practiced in montane forests in the Eastern Arc Mountains. Both management classes are represented in the SAGCOT region.

Corridors

Although relatively large areas are actively managed for conservation, intensifying pressure from human immigration in forest areas and the clearing of land for agriculture, grazing, fuelwood and charcoal is resulting in widespread deforestation, particularly in areas that function as wildlife corridors between one protected areas and another. Protected areas alone do not have the resources to support critical biodiversity, especially large migratory species. Movement through the wildlife corridors protects genetic diversity, preventing localized extinction, maintain habitat diversity, and distributing wildlife pressure across a larger area. Nearly all species found in protected areas are also found in corridors, in fact some species are found only in corridors, suggesting that, while protected areas cover many critical habitats, they do not cover all habitat types. However, the number of animals using the corridors is dwindling each year. Many of the corridors in SAGCOT appear to have closed or are expected to close in the next decade if measures are not taken to manage the corridors for wildlife and reduce conflict with farmers.

Table C-4: Designated conservation areas in the Southern Corridor.

Conservation areas	Description	Area (sq. km.)	Percent of Total Land
National Park	Katavi, Kitulo, Mikumi, Ruaha and Udzungwa national parks span a range of ecosystems from wetlands and Miombo woodlands to montane forests and savanna.	17,754.8	5.8%
Game Reserve	There are several game reserves including Kipengere/Mpanga, Kizigo, Rungwa, and Selous which support large game hunting and act as corridors between national parks.	49,551.5	16.1%
Game Controlled Area	Includes Lunda-Mkwabi and Rukwa are the only in the corridor. Both areas are operating more as de facto open areas than protected areas.	9,702.4	3.2%
Forest Reserve	Forest reserves managed entirely or jointly by districts, villages and state actors are scattered across the corridor and are important areas for protecting resources and connecting habitats.	21,945.9	7.1%
State Forest Reserve	Forest reserves that are not managed jointly by villages or districts, rather entirely by the central government	5.9	0.0%
Wildlife Management Area (WMA)	Idodi-Pawaga, Ngarambe-Tapika, Twatwatwa, Ukutu, and Wami-Mbiki are the five WMAs in the corridor that help to connect protected areas and manage natural resources, in many cases wildlife for commercial hunting.	3,147.9	1.0%
Wetlands of International Importance (Ramsar)	The RAMSAR classified Kilombero wetlands protect important biodiversity resources including indigenous and threatened species while still permitted some use of the land.	9,007.6	2.9%
World Heritage Site	Selous Game Reserve is considered to protect species and ecosystems that contribute significantly to our world's natural heritage. UNESCO helps to fund management plans in such areas.	----	----
Total conservation areas		**111,116.0**	**36.1%**
Total land area		**307,456.6**	**100.0%**

Human-wildlife conflict occurs most often in the widest corridors when animals trample crops or pause in their journey to raid crops for food. Farmers, in efforts to protect their crops and personal food security, will kill wildlife. Some management options, like fencing, are too costly to implement at large scales. Perhaps the best opportunity for managing human-wildlife is to survey residents about wildlife movements and work through Village Land Use Plans to designate a network Village Forest Reserves that will provide habitat and food for migrating animals. Currently, however, very few of these corridors are actively managed to protect these species or mitigate the conflict caused with farmers in the corridors. Table C-5 highlights the notable species found in the wildlife corridors that fall within SAGCOT boundaries.

Table C-5: Wildlife corridors in SAGCOT, the notable species found there and current threats.

Name	Area	Primary species	Current threats and efforts to protect
Bujingijila Corridor	Between Rungwe and Livingstone Forests	Kipunji, Abbott's Duiker, Bushbuck, Tungwe Galago, Sharpe's Black and White Colobus, Leopard	Deforestation, lack of active forest management, hunting and charcoal production also threaten forests.
Igando-Igawa	Between Mpanga-Kpengere Game reserve, Kipengere Forest Reserve and Kitulo National Park	Buffalo, Bush Duiker, Eland, Elephant, Red Duiker, Zebra, Caracal, Serval, Leopard and Lion	Habitat clearance for agriculture and charcoal production.
Loazi-Kalambo	To the east of Lake Tanganyika	Eastern Chimpanzee, Bush Duiker, Bushbuck, Hartebeest, Lesser Kudu, Waterbuck, Zebra, Lion and Leopard	Critical chimpanzee habitat is being cleared for charcoal and then put into agriculture. There is no active management of the Kalambo and Loazi forest reserves.
Loazi-Ntantwa-Lwafi Corridor	To the east of Lake Tanganyika	Similar to the Loazi-Kalambo Corridor, with particular significance for chimpanzee populations	Pressure from charcoal production, Bushmeat hunters and lack of management. Bushmeat is exported illegally for sale in the Democratic Republic of Congo.
Udzungwa-Mikumi	Between Udzungwa and Mikumi National Parks	Elephant, Buffalo, Sable, Waterbuck	Poaching, habitat clearing for agriculture, human-wildlife conflict. Elephant passage through the corridor is seriously threatened.
Udzungwa-Ruaha	Mountainous region between Udzungwa and Ruaha National Parks	Elephant, Leopard, Spotted Hyena, Greater Kudu, Impala, Burralo and Giraffe	Poaching, habitat clearing for agriculture, human-wildlife conflict. Immediate action needs to be taken to preserve this connection between the northern and southern elephant populations in Tanzania and reduce human/elephant conflict.
Udzungwa-Selous (Nyanganje and Ruipa Corridors)	In and around the Kilombero Valley	Elephants, Buffalo, Bushpig, Hippopotamus, Udwangwa Red Colobus, Angolan Colobus, Yellow Baboon, Spotted Hyena, African Civet, Aardvark, Crested Porcupine, Harvey's Duiker, Waterbuck,	Both corridors are under immediate threat, with high levels of human/elephant conflict and increasing human activity, especially agriculture
Udzungwa Scarp-Kilombero (Mngeta Corridor)	North of the Kilombero Ramsar site	Several endangered and endemic species to the Udzungwa Mountiains including: Sanje mangabey, Udzungwa red colobus, Abbott's duiker	Human migration to Kilombero Valley and subsequent agricultural development; stakeholders met in 2007 and discussed management of the Scarp ecosystem
Uluguru North-South	Uluguru Mountain region of the Eastern Arc range	Uluguru Bush Shrike, Loveridges Sunbird, as well as forty-four endemic vertebrate species	Deforestation, village expansion, agriculture; a new reserve has been proposed to join the Uluguru North Uluguru South and Bunduki forest reserves with regenerated forest A new nature reserve has been

Name	Area	Primary species	Current threats and efforts to protect
			proposed that joins Uluguru North, Uluguru South and th Bunduki forest reserve that would allow the forest to regenerate and connect the reserves again.
Wami Mbiki-Handeni (Southern Masai Steppe)	North of Wami Mbiki	Elephants, Buffalo	The corridor is still largely forested although pressure from villages to removing intact forest and illegal hunting is becoming more common.
Wami Mbiki-Jukumu/Gonabi/Northern Selous	South of Wami Mbiki	Buffalo, Greater Kudu, Hartebeest, Waterbuck and Wild Dog	Increasing human activity, settlements along the Morogoro Road and hunting pressure.
Wami Mbiki-Mikumi	Area around the Morogoro-Dodoma Highway between Wami Mbiki and Mikumi	Possible Elephant and Buffalo movement	Cattle farming with fencing limits wildlife movement, areas unfenced are close to villages and a highway, increasing human activity
Wami Mbiki-Saadani	West of Dar es Salaam	Elephants and Buffalo	Deforestation, village expansion and charcoal production. It is unlikely that wildlife, which must cross the Chalinze-Arusha highway, will continue to use this route for long.

Forest degradation and deforestation are not only local and regional concerns, they have global implications because of their effects on terrestrial carbon stocks held in forests and savannas that contribute to carbon emissions and influence climate change. Reducing Emissions from Deforestation and Forest Degradation (REDD) is a United Nations program that aims to decrease carbon emissions that come of forest degradation in developing countries by providing financial incentives for maintaining forests to protect stocks of terrestrial carbon. The new program, REDD+ goes one step further to compensate communities for the conservation and sustainable management of forest resources.

Tanzania is currently in the process of experimenting with REDD+ through a set of nine pilot projects that are testing different methods for project implementation, community engagement, benefit sharing, and ecosystem monitoring. Three of the pilot projects are situated in the Corridor and engage communities primarily through PFM arrangements. While PFM arrangements can complicate the process of splitting the income generated by REDD projects between village and central government actors, REDD can strengthen community management and tenure when governance laws are appropriately enforced. Pilot projects are helping communities to establish forest boundaries, diversify income generating activities, support village land use planning and improve communities' capacity to own and manage their own forest resources. REDD partners in Tanzania have found the costs of initiating REDD projects and the uncertainty of financing mechanisms for REDD to be major barriers to engaging communities in REDD projects. In SAGCOT, where agriculture is a primary driver of deforestation, the success of REDD will depend on aligning REDD strategies with agricultural policies and guaranteeing benefits for smallholders.

The complex interactions between wildlife, forests, agriculture, water and other resources is inciting the development of landscape- and watershed-scale approaches that can address the multiple threats and opportunities to biodiversity and wildlife inside and buffering protected areas. New partnerships are being established to bridge stakeholders and address these problems in holistic and cost-effective ways. Strengthening the Protected Area Network in Tanzania (SPANEST) is one such partnership that brings

together the Tanzania National Parks Association (TANAPA) with the United Nations Development Programme (UNDP) and the Ministry of Natural Resources and Tourism (MNRT) to support the management of the Greater Ruaha Landscape of 27,000 sq. km and the Greaer Kitulo-Kipengere Landscape of just more than 2,000 sq. km. Both areas are important sub-basins within the Rufiji River system. The hope is that strengthening protected area management in the Southern Circuit through integrated management will help bring more development to all sectors as well as encourage the sharing of economic, social and environmental benefits at local, national and international scales.

Climate Change

As described in the Economics of Climate Change (ECC) in the United Republic of Tanzania report, the economic and environmental impacts of climate change in Tanzania, while uncertain, are likely to be large. Overall economic losses due to climate change are expected to equal 2% of GDP each year until 2030. The country can also expect an average increase in temperatures of 2°C by 2050, accompanied by increasing rainfall variability and frequency of extreme weather events such as droughts and floods. The Eastern Arc Mountains may be one of the few areas in the country that will not experience decreased rainfall during the short rainy season. However, other nearby areas—in particular the upper reaches of the Wami-Ruvu and Rufiji basins—will most likely experience a decrease in rainfall, resulting in up to a 10% decrease of water flow to these rivers.

In the agricultural sector, irrigation potential and yield could be the most affected by climate change. The agricultural report produced by the Economics of Climate Change (ECC) in Tanzania estimates that adaptation to climate change in the agricultural sector will cost an additional US $107 million each year above and beyond current investments to grow the sector. Maize yields are likely to suffer the most from climate change, with an average decrease in yield of 14% by 2030, and 23% by 2050. In the most drought prone regions, such as Dodoma and Tabora, cereal yield losses could reach up to 80%. However, these predicted trends are not true for all crops. For instance, coffee yields are expected to increase in the highlands. While the costs in any case are likely to be high, the uncertainty of the effects of climate change can make specific and targeted recommendations for local action a challenge.

This uncertain future has many implications for investment in the agricultural sector. While Tanzania's carbon emissions from agriculture (total and per capita) are still relatively low when compared with those from developed countries, maintaining a path toward low carbon growth in agriculture could offer many potential benefits in terms of adaptation funding and economic and social resilience of Tanzania smallholders, who form the majority of Tanzania's agricultural work force. The ECC report highlights five areas of potential investment that could support vulnerable populations and protect the sector's productivity: irrigation, soil and water conservation, agricultural research, agricultural extension and improvement of rural roads. The intersection of these agricultural investments will need to be considered carefully. Therefore, future analyses on the actual costs and the cost to adapt now versus in a more difficult future should be made and considered by multi-sector bodies to choose the best path toward a low carbon future for Tanzania.

Kilombero Cluster: Key Features, Trends, and Challenges

The Kilombero Cluster covers parts of Kilombero and Kilosa Districts in Morogoro region and a part of Kilolo District in Iringa Region. Nestled between the Kilombero River to the Southeast and the Udzungwa Mountains to the Northeast is the Cluster's most notable feature, the vast Kilombero floodplain known for its agricultural productivity and internationally recognized for its conservation value. The area experiences a bimodal rain pattern, with long rains from November to January and short rains from March to June. The rains result in annual flooding of the floodplain which supports smallholder rainfed agriculture and dry season irrigation schemes on commercial farms. The permanent wetland adjoining the floodplain supports one of the largest inland fisheries in Tanzania. The majority of

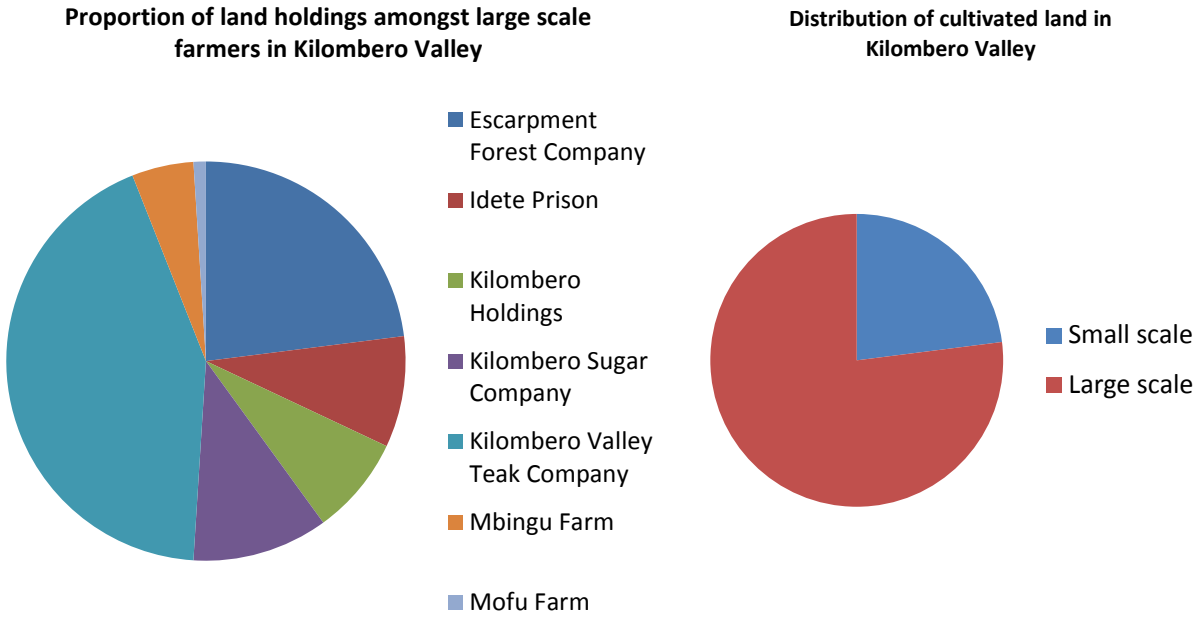
the population depends directly on the agriculture, livestock, fisheries and forestry systems supported by the floodplain.

To the North and South of the floodplain are two important protected areas connected to the floodplain, Udzungwa National Park and Selous Game Reserve. The forests in the Kilombero Valley are important corridors for wildlife seeking to migrate from one protected area to another. Human-wildlife conflict is a challenge for crop farmers and pastoralists in rural areas and small villages. Most of the Cluster is rural, although 27% of the Clusters's 286,000 residents live in urban areas, especially in the main population center, Ifakara. Although the Tanzania-Zambia railway passes near Ifakara, most residents rely on the network of roads for personal transportation and access to markets in Morogoro and Dar es Salaam.

Land patterns

The Kilombero Valley Floodplain is one of the most important wetlands in Tanzania. Situated between Udzungwa National Park and Selous Game Reserve, this web of rivers, canals and lush plains surround the Kilombero River. These nearly 800,000 hectares of flood plain are among the most valuable in Tanzania for large scale paddy rice and sugarcane production due to seasonal flooding and potential for large scale irrigation schemes. Unlike the rest of Tanzania agriculture which is typically dominated by smallholders, only 23% of the total area under cultivation in the Kilombero Valley is cultivated by smallholders while 77% is owned by large scale famers (see Figure C-1). At present more than 50% of the floodplain is under cultivation. Increasingly, pastoralists from other parts of Tanzania are migrating into the Kilombero Valley Floodplain in search of large tracts of new grazing lands, increasing the pressure on the small area of land allotted to smallholders and inciting conflict with crop farmers.

Figure C-1: Proportion of land holdings by large scale farmers and the total distribution of cultivated land in Kilombero Valley.



Source: Mombo et al. 2011

The Cluster also has large areas of deciduous forests, including plantations managed for harvest as well as the natural forests. These areas are important habitat for wildlife, but growing populations and agricultural land use is causing these forests to become fragmented. Evergreen forests are found on the slopes of the Udzungwa Mountains. These forests are also becoming degraded by the smallholders who move from the increasingly crowded floodplain, up the slopes to clear cropland and harvest forest resources for fuel and timber. Cropland and cropland mosaics are found in the center of the floodplain. Although productive, many smallholders so not live by their plots in

Table C-6: Land cover in the Kilombero Cluster.

Land Cover	Area (sq. km.)	Percent of Total Land
Artificial areas	6.4	0.1%
Croplands (crops occupy >70% of area)	190.0	3.5%
Mosaic croplands (crops occupy <70% of area)	672.5	12.2%
Evergreen forest	640.2	11.6%
Deciduous forest	3,172.2	57.6%
Woodland	698.9	12.7%
Shrubland	58.7	1.1%
Grassland	0.7	0.0%
Wetland	64.7	1.2%
Total land area	**5,504.2**	**100.0%**

Agriculture and commercial forestry

Agriculture is one of the most important economic activities in the Kilombero and Kilosa Districts, employing about 80% of the labor force. As mentioned earlier, it is one of the most important, and productive regions in the country, especially for paddy and sugarcane. Other important crops in the Cluster are maize, cassava, bananas and sweet potatoes. Kilombero District is the second largest paddy producing region, but yields are low on average (~2 t/ha) when compared with other major rice producing regions, mostly due to dependence on rainfed agriculture, basic tools like the hand hoe and traditional practices like shifting cultivation. Although the floodplain has high potential for irrigated agriculture, irrigation schemes in Kilombero Cluster are relatively new and primarily owned by large commercial farms. Developing affordable, accessible irrigation technologies for smallholders is one of the foremost challenges for scaling up agricultural production in this Cluster.

Out-grower schemes and block farming are two approaches which have provided smallholders with access to cropland, inputs and irrigation since the privatization of the large government-owned farms in the Cluster. In some cases, as with Kilombero Plantations Ltd., it has proven an effective arrangement for providing extension services on new techniques like the System of Rice Intensification discussed in Annex B. Kilombero also has the oldest of the three well-developed cane grower associations in Tanzania. Kilombero Cane Growers Association (KCGA) is an example of a successful outgrower scheme, which supplies about 50% of the cane processed by Kilombero Sugar Company Limited (KSCL). Under the umbrella organization, Tanzania Sugar Growers Association (TSGA), KCGA provides important extension services to growers on farming, including sustainable techniques.

Maize, the third most abundant crop in the Cluster, is farmed almost exclusively by smallholders over approximately 26,000 ha in Kilombero District and 60,000 ha in Kilosa District in the foothills outside the floodplain. Maize is planted only in the rainy season and is the most common crop raided by

migrating wildlife. Among smallholders, the use of agricultural inputs remains low, due to poor market access. Livestock production is also limited, accounting for only 10% of the labor force. However, increasing immigration of pastoralists is creating more competition for land and water resources. Most cattle are indigenous breeds, with improved dairy breed representing less than 2% of the ~67,000 head of cattle in Kilombero District. Herder field schools have been proposed as a means of raising awareness on land and water concerns, introduce new grazing practices and connect herders to district grazing lands.

Forestry is not a major source of income for smallholders, but large-scale commercial teak plantations to supply international tropical hardwood markets make up a large portion of the land holdings in Kilombero. While the teak plantations owned by Kilombero Teak Company provide a source of employment for many households in villages near the teak plantations, there is concern that the establishment of new teak plantations will negatively impact large mammals and other wildlife that use the habitat corridors of miombo woodlands and evergreen forests that are immediately adjacent to the plantations.

Conservation areas and issues

In 2000, Tanzania ratified the RAMSAR convention which requires wise use of wetlands which meet its standards. The Kilombero Valley wetlands gained RAMSAR status due to their importance for national and international wildlife; in particular the presence of 75% of the world's remaining wetland dependent puku population. The wetland also has several species found only in the Rufiji River basin and provides important breeding grounds which support fish populations throughout the basin. Besides these concerns, there are two established elephant and buffalo corridors which cross the flood plain which are threatened to be cut of or discontinued by increasing agricultural production, destruction of the miombo woodland ecosystem which surrounds the valley and conflict between humans and wildlife.

The wetland had no management plan until 2006, after which funding was provided through the Belgian government for wise management of the wetland's resources. However land use in the valley remains complicated by competing demands by agriculture, forestry, water and wildlife sectors. Official oversight through RAMSAR is provided by the Ministry of Natural Resources and Tourism. However this ministry can only establish policies on wildlife use and management, not for the other competing uses which, by Tanzania law, are under the jurisdiction of other ministries. Unfortunately, international recognition does not always translate to local awareness as 87% of the population is not aware that the wetlands are legally protected under the RAMSAR convention[39].

Smallholder and conservationists are concerned with the increasing forest fragmentation and encroachment of agricultural land on forested areas. Surrounding the Udzungwa Mountains National Park are at least five forest reserves/areas upon which more than fifteen villages depend for food, income and fuel. Officially annexing these forest reserves to the national park or establishing joint or community forest management plans between villages and local stakeholder bodies would not only protect the communities' continued access to forest resources and services, but it would also protect highly important corridors for wildlife movement between protected areas. Several stakeholder meetings and workshops among community members have identified community interest in managing resources. They have also brought to light the need for flexible and integrated management plans that allow different types of use including certain types of agriculture upon which nearly the entire population of the valley depends.

Human-wildlife conflict (HWC) in Kilombero Valley is a challenge requiring immediate attention. Only two corridors remain in the valley for wildlife including buffalo, elephants and puku to cross from Selous Game Reserve to the Udzungwa Mountain National Park. Both of the corridors are critically threatened from pressure by livestock encroachment, deforestation and continuing immigration of human

[39] Mombo et al. 2011

populations. The most important consideration in successfully managing these corridors is mitigating HTC. In the Nyanganje Corridor, between Nyangaje Forest Reserve and Selous, more than 80% of residents reported elephants passing through their farms. Since this corridor is the shortest possible route across the valley, the elephants do not always pause to raid crops resulting in slightly lower levels of perceived conflict. However in the Ruipa corridor, near the Ruipa River, there is evidence of the corridor being closed off by hunting pressure, teak plantation and agricultural expansion. Here, where the animals must cross a larger distance to reach the next protected area, nearly half of the residents perceive conflict with large mammals passing through their land.

The southern part of the valley has been designated as a Game Controlled Area, which although is protects against illegal hunting has no control over the encroachment of livestock grazing or expansion of agriculture into wildlife corridors. Several new management approaches have been proposed however there is a lack of capacity and extension services that provide education on the importance of wildlife corridors to residents and sustainable forestry management that allows fuel wood and timber harvesting as well as some cultivation and controlled grazing.

Table C-7: Designated conservation areas in the Kilombero Cluster.

Conservation areas	Description	Area (sq. km.)	Percent of Total Land
Forest Reserves	Thirteen forest reserves, primarily owned by villages.	1,124.4	20.4%
Game Reserve / World Heritage Site	Selous Game Reserve, one of the largest remaining wilderness areas with large populations of game species.	88.5	1.6%
National Park	Mikumi National Park, contiguous with Selous Game Reserve, has large populations of large game animals and Udzungwa National Park is known for biodiverse moist upland forests.	1,258.9	22.9%
Kilombero Valley Ramsar site	Covers the wetland and parts of the surrounding floodplain that support critical habitat for indigenous and threatened species.	2,556.4	46.4%
Total conservation areas		**5,028.2**	**91.4%**
Total land area		**5,504.2**	**100.0%**

Social and economic trends

Interestingly, although the Cluster has a wealth of opportunities for agriculture and water for hydropower, local residents have incomes far below the Tanzania average and only 1% has access to electricity. Considering the wealth of natural resources and income generated by agriculture and water resources from the region, it seems clear that many of the benefits of development activities related to the wetland and floodplain are being externalized or diverted from the smallholders who manage much of the wetlands and forests in the region. Internalizing the costs and finding ways to compensate residents for wise management of natural resources could be an important part of developing the valley.

The lack of infrastructure for energy and transportation limit market access for smallholders. Similarly, infrastructure for health and education has not grown as fast as the local population. However, Kilombero District has been able to attract the attention of many NGOs and CBOs that report beneficiaries totaling more than half the district population, more than in any other district in Morogoro Region. In general the Cluster faces many of the challenges that are typical of rural areas. Development activities in the Cluster

will mostly likely have positive indirect benefits for income, education, and social amenities particularly if investors are required to pay communities for the land and resources they use through provision of social services and amenities.

Ihemi Cluster: Key Features, Trends, and Challenges

The Ihemi Cluster covers a portion of Iringa Region, a diverse region including the eastern-most part of the southern highlands and one of the agricultural strongholds of the country. It is one of the leading regions in maize and horticultural production, which supplies local food processors. The Cluster boundaries also encompass deciduous and evergreen forests rich in biodiversity which also contribute to the region's pulp wood and timber industries. The Cluster falls within the Great Ruaha River basin which flows down to feed the Mtera reservoir in the Northeast part of the Cluster. The surrounding area is also home to the largest iron ore deposits in Tanzania, as well as a significant coal deposit.

Iringa is the main population center and, with a population over 100,000, has grown large enough to merit its own district, Iringa Urban, which is situated at the heart of the Cluster. The two major regional roads coming from Dodoma and Morogoro meet in Iringa before continuing on to Mbeya in the far western part of the country. For that reason, Iringa is a regional center for trade, as well as health and education institutions. While poverty is not as severe as in other Clusters, the high prevalence of HIV/AIDS is a primary challenge, affecting nearly all social and economic systems.

Land patterns

The Ihemi Cluster, covering Iringa Urban District and part of Iringa Rural, Kilolo and Mufindi Districts, is up on the plateau of the southern highlands. The region's climate is unique in its heterogeneity, varying between the bimodal and unimodal rainfall patterns, which in turn results in diverse land uses. Forests, woodlands and mosaic cropping systems are the largest land uses in the Cluster. Forest types vary from managed to natural across the Cluster from more than 160,000 ha of montane forests high up the Udzungwa escarpment in Kilolo District to the lowlands in Iringa Rural District in the Northwest toward Ruaha National Park. Most of the large-scale commercial tea and pulp wood plantations are in Mufindi District along the main highway from Iringa to Mbeya. Cropland mosaics are found throughout the Cluster with more drought resistant crops in the lowlands.

Table C-8: Land cover in the Ihemi Cluster.

Land Cover	Area (sq. km.)	Percent of Total Land
Artificial areas	18.1	0.1%
Croplands (crops occupy >70% of area)	213.8	1.5%
Mosaic croplands (crops occupy <70% of area)	3,529.7	24.4%
Evergreen forest	738.7	5.1%
Deciduous forest	2,753.7	19.1%
Woodland	2,724.0	18.8%
Shrubland	3,232.4	22.4%
Grassland	1,114.6	7.7%
Wetland	115.0	0.8%
Water bodies	11.4	0.1%
Total land area	**14,451.3**	**100.0%**

Agriculture, livestock and commercial forestry

Besides being one of the "Big Four" regions for maize production (Iringa, Mbeya, Ruvuma and Rukwa), Iringa is the country's leading region for potatoes (70% of national production) and tomatoes and an important producer of timber, tea, sunflower and processed fruits and vegetables. Although there is generally enough water for two planting seasons, the region is very heterogeneous and increases in temperature and rainfall variability are affecting maize yields in some parts. Sunflower seed is an alternative crop that grows under similar conditions to maize but is less sensitive to climatic variability. The area under sunflower production has more than doubled over the last five years as farmers seek alternatives to maize in places where it is perceived as too risky. Farmers are exploring simsim (sesame) as another alternative to maize that could take advantage of the existing infrastructure for processing sunflower seeds.

Mufindi district is the second largest producer of tea in Tanzania. Most production takes place on large commercial tea estates, with smallholders participating through outgrower arrangements. Tea is processed in Mufindi and exported to both conventional and fair trade international markets. The Cluster also supplies national markets with potatoes, tomatoes and onions. Most of these products are transported to Dar es Salaam for sale with the exception of tomatoes, most of which are sold to Dabaga, one of the largest fruit and vegetable processors in Tanzania. Irrigation is important for all of these crops. Many smallholders rely on traditional irrigation systems like *vinyungu,* which makes use of river valley bottoms for dry season production. Some commercial tea growers have modern efficient irrigation systems, but economies of scale make these systems too costly for most smallholders.

Livestock is the second most important economic activity in the Cluster. In 2003, the region had a herd of nearly 500,000 head of cattle, managed primarily for meat. Dairy cattle make up less than 1% of Iringa's herd, although the highlands are considered high potential for livestock development and dairy in particular because of the year-round availability of fodder, relative low prevalence of tick-born diseases and high demand for dairy products. Only 3% of the cattle in the region are improved breeds. At this point, infrastructure is insufficient to support sector development. Investments in veterinary services, watering facilities and dairy processing facilities would be necessary to scale-up production.

Commercial forestry has been an important part of the region's past and is expected to play a role in encouraging economic development through reforestation. The original owner, Southern Paper Mills, a subsidiary of a national company, was installed in 1965 with investments from domestic and international partners, however operations ceased in 1992 due to lack of national demand and inadequate energy resources to power the mill. Since then, Mufindi Paper Mills has taken oven operations and plans to steer the business into sustainable production in partnership with the Sao Hill Plantations which will supply the pulp wood. Most commercial plantations are owned by large companies, however recent efforts have been made to involve smallholders in commercial forestry as a means of incorporating them into carbon trading markets.

Conservation areas and issues

The Cluster is part of the Great Ruaha River catchment. Competing demands for the Ruaha's water abound with a large regional population, important wildlife areas and highly productive irrigated agriculture downstream. Over-abstraction of water for irrigation and climatic changes has resulted in more frequent drying of the upper reaches of the basin. Just as the seasonal variability presents a challenge to rain fed agriculture, the periodic drying of surface water is a challenge to building and maintaining irrigation systems that provide regular access to water for agriculture without threatening the needs of downstream water users. While water shortages may be caused by misuse is the upper reaches of the basin outside of Ihemi Cluster, downstream users look toward upstream users immediately above the Mtera reservoir when water levels in the reservoir drop.

Unlike in some of the other Clusters, deforestation in Ihemi Cluster is not driven primarily by conversion to agriculture, but rather by charcoal, fuelwood, timber and pulp harvesting. Thanks to national policies on tree harvesting residents recognize the importance of maintaining tree cover for protection of water resources as well as the timber and pulp industries. In effort to decrease deforestation, some communities are beginning to explore the use of biogas as an alternative for household cooking fuel. Perhaps it is due to the abundance of forest resources or dependence of villages on forest resources, Iringa region has dedicated large areas of land to PFM. It leads the country in area under JFM (274,193 ha) and has another 166,057 ha under CBFM. Forest reserves compose 9% of the region's area and forest plantations for timber and pulp another 4%. Apart from Udzungwa Mountains National Park and Ruaha National Park, which are managed by the central government, more than 120 villages are involved in Community-based Forest Management and more than 50 villages have Village Land Forest Reserves (VLFRs) formally recognized by the government compared to the occasional one or two VLFRs gazetted in other regions.

Table C-9: Designated conservation areas in the Ihemi Cluster.

Conservation areas	Description	Area (sq. km.)	Percent of Total Land
Forest Reserves	Kilombero Forest Reserve, and other forest reserves are often managed through participatory forest management across the cluster.	1,605.1	11.1%
Game Controlled Area	Lunda-Mkwabi Game Controlled Area, adjacent to the southeastern border of Ruaha National Park. Although formally gazetted, the area is not actively managed as a game controlled area.	5.9	0.04%
Total conservation areas		**1,611.0**	**11.2%**
Total land area		**14,451.3**	**100.0%**

Social and economic trends

The abundant resources, established infrastructure, and high agriculture and forestry potential put this Cluster in a position to attract partners that are looking for quick wins. The government has invested in Export Processing Zones (EPZs), similar to free trade zones, to encourage investors from many sectors including agro-processing and agricultural equipment manufacturers. Additionally, an international airport being built not far away in Songwe plans to devote a terminal to agricultural and horticultural exports, serving as a dry port for regional producers.

Socio-economic conditions in the Cluster are mixed. Given that the labor force is overwhelming involved in agriculture just as in other Clusters (70-90% outside of Iringa Urban district), incomes are surprisingly higher here than in most other parts of Tanzania except Dar es Salaam. In 2008 regional per capita GDP was 861,564 Tz Shs compared to the national average of 627,787 Tz Shs[40]. This is most likely due to the productivity and diversity of the region's agriculture and forestry industries. However, HIV/AIDS prevalence is a serious challenge, with 16% of the population affected compared to the national average of 5.7%. The unbalanced sex ratio (89 males to 100 females) and age distribution of the population (45% of the population less than 14 years old) are products of this higher incidence of HIV/AIDS in combination with emigration to urban centers. Promoting access to quality health care will be critical in enabling residents to take advantage of employment opportunities, participate in land use planning and management and engage in new partnerships with investors.

[40] Iringa Region GDP Report 2008

Key Features, Trends, and Challenges in Mbarali Cluster

The Mbarali Cluster is in the Mbeya Region in the western reaches of the Southern Highlands. As in Kilombero Valley, paddy is the major crop in the in the wetlands of the Usangu Plains. District-wide, maize is a close second in terms of area under production. The Cluster has a long history with irrigated agriculture in the Usangu Plains, since the early 1900s. Now irrigation is common throughout the Cluster except forested and protected areas. Typically irrigation is used for paddy in the wet season and to plant additional horticultural crops in the dry season. Mbarali district has more than 85 irrigation schemes, which include traditional, improved and modern systems. The majority of the Cluster's irrigated land (about 25,000 ha of the total 35,000 ha) is irrigated by traditional systems that are now in ill repair and whose inefficiency is faulted for over-abstraction of water during the dry season. Livestock, another important piece of agriculture in the Cluster, was pointed to by downstream water users as the primary cause of the first zero flow periods in the Ruaha River in the 1900s due to the immigrant pastoralist populations moving in to water large herds during the dry season. Since then it has become apparent that irrigation, more than livestock, is causing the increasing number of zero-flow days seen downstream. Livestock keeping is an important source of income for the Sukuma, who own 90% of the cattle in the Usangu wetland area, and other traditionally pastoralist groups, but competition over land and water resources continues to cause conflict between pastoralists and crop producers. In the upper reaches of the basin, away from the flats these conflicts lessen and are primarily upstream-downstream user conflicts over water allocation. However, in the flats, where irrigation and crop production is more common, these conflicts are very often due to the crop and irrigation system damage caused by livestock driven in search of water.

Table C-10: Land cover in the Mbarali Cluster.

Land Cover	Area (sq. km.)	Percent of Total Land
Artificial areas	11.0	0.1%
Croplands (crops occupy >70% of area)	129.5	1.4%
Mosaic croplands (crops occupy <70% of area)	3,175.1	35.2%
Evergreen forest	--	--
Deciduous forest	91.7	1.0%
Woodland	380.5	4.2%
Shrubland	1,030.6	11.4%
Grassland	4,043.2	44.8%
Wetland	162.6	1.8%
Water bodies	0.7	0.0%
Total land area	**9,024.9**	**100.0%**

Conflicts over water resources present a serious challenge for all sectors. The rivers and streams that supply water to the region's irrigation schemes flow through the Usangu wetlands to the Ruaha River and on to the Mtera dam, the nation's largest hydroelectric station. Besides the hydroelectric water use, commercial rice farmers, smallholder farmers, pastoralist and fishermen are all relying on the region's water resources. Also, residents contend for rights to access and manage the Ihefu wetlands, From 2006-2008 the government formally annexed the Ihefu wetland portion of the Usangu wetlands to Ruaha National Park, which is managed by the central government through TANAPA. This resulted in the displacement of several thousand residents, many of whom, although they received some compensation, are still in unstable land tenure arrangements. Before annexation about Mbarali District was

approximately 15,000 km^2, now the district is estimated at 5,000 km^2 but the size is uncertain due to ongoing land and tenure disputes. The expansion of Ruaha National Park to include what was previously Usangu Game Reserve generated conflict between the government, who cited the need to annex the game reserve to preserve biodiversity and safeguard downstream hydroelectric provision by protecting the use of wetlands in the Usangu Game Reserve, and residents, who claim they were not fairly compensated by their land and were not granted access to the permanent jobs available in the park. The expansion also made Ruaha National Park the largest national park in Tanzania, which has potential to increase tourism to the area as well.

Table C-11: Designated conservation areas in the Mbarali Cluster.

Conservation areas	Description	Area (sq. km.)	Percent of Total Land
Forest Reserves		164.7	1.8%
Game Controlled Area		161.3	1.8%
Game Reserve		2,967.4	32.9%
Total conservation areas		**3,293.4**	**36.5%**
Total land area		**9,024.9**	**100.0%**

Besides the recently annexed portion of Ruaha National Park and Kitulo National Park, WWF has supported the development of the Mpanga/Kipengere Game Reserve to protect biodiversity and water resources in the upper reaches of the catchment supplying the Usangu wetlands. About 20,000 ha of smaller forest reserves are scattered throughout the Cluster and under CBFM. Apart from cultivated crops, the forest reserves provide important sources of edible forest fruits which supplement the dietary staples. Providing an important source of habitat for migratory species during the dry season is the Igando-Igawa wildlife corridor which follows the path of the rivers as flow from the Mpanga/Kipengere Game Reserve to the former Usangu Game Reserve and Ruaha National Park. Land use planning and forest management has not been strong in the region, possibly because recently resettled populations from the Usangu Game Reserve area remain in conflict with government officials about access to land, water and social resources that can support their families, crops and livestock.

In 2006, during a national process to privatize government-held farms in Mbarali, Kapunga, Ruvu and Dakawa, Highland Estates Company and the Export Trading Company LTD purchased the two largest rice farms in the Usangu plains which, previously, were a part of the National Agriculture and Food Company (NAFCO). Mbarali Rice Farm, a 5,842 ha farm was purchased for Tsh 3.5 billion by Highland Estates sublets almost half of the farm area to cooperative groups including more than 800 small-scale farmers. The second farm, Kapunga Rice Project, encompassing 7,450 ha of rice farm, was sold in 2006 to Export Trading Company for Tsh. 2.3 billion and sublets only around 800 ha of the farm to small-scale farmers and cooperatives. As a result of privatization, many of the improved and modern irrigation systems on the farms are now unavailable to smallholders. Irrigated agriculture is the base of the local economy. The maximum area of irrigated paddy is estimated to be 42,000 ha with a core area of 24,500 ha. but unresolved land tenure and lack of financial institutions to provide credit limit smallholder's ability to participate in highly productive and cost-effective irrigated agriculture. Also, the Cluster does not have a network of post-harvest storage facilities or warehouses that might help small farmers to work together for improved access to markets and capital.

Annex D: AGG Development Program Calculations

This Annex provides additional detail on the AGG development projections presented in Chapter 9. These projections are based on a model created by the Green Growth Technical Team to predict the effects, over the next twenty years, of the implementing the AGG strategy in this Greenprint. Of course, no model is capable of precisely predicting the future, and there are many unknown factors that will affect the future of the Southern Corridor. Nevertheless, the model is a helpful tool for understanding, in general terms, the likely impacts of AGG versus other development trajectories that the Southern Corridor could follow. As additional information becomes available in the future, the model can be continually refined so that it remains a useful decision-making tool.

Factors for estimating SAGCOT development program impacts

The impact of mainstreaming AGG in the Corridor will depend on a range of factors. The model considers the impact of land use and management changes attributable to the AGG strategy itself, as well as ongoing trends such as population growth and other development plans, including those identified in the Blueprint. The model compares development outcomes under two contrasting scenarios. One scenario is based on a development strategy that implements agricultural intensification with prevailing practices (AIPP), including input intensive agriculture without explicit environmental management at farm and landscape scales. The magnitude of agricultural expansion and intensification under this scenario is generally based on projections provided in the SAGCOT Blueprint. The AGG scenario describes a development trajectory that begins with the same prevailing practices but progressively incorporates sustainable intensification practices as described in the Greenprint. The model focuses on three sets of food crops: 1) rice; 2) sugarcane; and 3) field crops (consisting of oilseeds, legumes, and grains other than rice). These crops were chosen because they are important commercial and/or food security crops, have data available from the national agricultural census, are targeted for development by the SAGCOT initiative, and are the focus of sustainable intensification practices in the AGG strategy (e.g., conservation agriculture, SRI and precision agriculture).

The model contains three sets of modules. The **input modules** provide data on existing conditions, trends, and assumptions, from the best available information sources. As part of the input component, a "background trends" module considers population trends and dynamics, including population growth in the Corridor as well as regional patterns rural-urban migration in order to understand the dynamics of food provision to a growing population in the context of mixed production for subsistence use and market supply. The next sub-section describes some additional key inputs. The **calculation modules** combine information from the input modules using formulas that multiply per-area impacts by estimated scale-up trajectories for various AGG and conventional practices. These modules also incorporate certain feedbacks, such as the effects on smallholders of moving from food-insecure to food-secure status due to sustainable intensification. Finally, the **output modules** reports estimated impacts for food production, agricultural expansion, deforestation, water saving, and avoided carbon emissions under the two production scenarios.

Model inputs

The data and assumptions used in the model came from four main sources: 1) the development targets outlined in the Blueprint, which were to inform the creation of the AIPP scenario; 2) national agricultural census data on crop areas and yields; 3) estimates of the roll-out trajectory of AGG practices, based on information provided in Chapter 5; and 4) current peer-reviewed scientific literature on the impacts of AGG practices on yield and ecosystem services. The assumptions included in the model are generally conservative with respect to the benefits that could be provided by AGG. For example, the model assumes that commercial producers and their associated outgrowers would not be responsible for deforestation or

encroaching into protected areas. The Blueprint's calculations were used to estimate the growth of large scale commercial producers and outgrowers. Regarding potential yields under the two scenarios, we examined yields achieved in similar systems in countries that have experienced rapid agricultural development, such as Brazil and part of Southeast Asia. When possible, data on the agricultural systems were gathered directly from producers or scientific literature from the Corridor itself. Estimates of population growth rates and migration trends affecting the Corridor's population growth are both based on national reports.

Impact pathways

An important intermediate step in the model calculations was to estimate the land area under each type of production system (AIPP vs. AGG), for each type of cropping system, and for each of three types of farmers (large commercial farms, affiliated smallholders, and unaffiliated smallholders). Each permutation of these categories had different estimated impacts on yield and ecosystem services. Land area estimates were calculated in five-year increments (five, ten, fifteen, and twenty years following program initiation). At each time step, land areas are updated. Yield estimates are treated dynamically depending on which systems and technologies are being used at a given point in time and how experienced producers are with implementing the systems. As yields change, the land area under production is subject to feedbacks, as some low-yielding fields on marginal lands are abandoned, pressure for the expansion of subsistence production is reduced, but large-scale commercial agriculture expands in area to take over some previously subsistence areas. The model iterates the production calculations with the new areas until the end of the model projection period after 20 years.

The water savings and avoided greenhouse gas emissions calculations are also based on land areas, combined with inputs on water use efficiency and net greenhouse gas emissions of AIPP vs. AGG. The area of avoided deforestation for the AGG scenario is derived from land use change calculations. Such calculations assume that subsistence farmers who have low yields and do not adopt AGG will continue to convert woodlands, savannas, and some forest to cropland to meet subsistence needs for the growing population. Under AGG, smallholders who achieve food security through AGG (even with population growth) are not driven to clear more land; some remain as subsistence farmers on their existing plots, some become commercial farmers, and some leave agriculture to pursue other opportunities. Using the land area of avoided deforestation attributable to AGG, the model calculates the climate mitigation potential of avoided deforestation based on the level of carbon stocks in standing forests, woodlands, and brushlands.

Opportunities for refining the model

The model uses data and assumptions from the most reliable available sources. However, few of the data came directly from measurements taken in the Corridor, and, even where they do, it must be recognized that the Corridor is highly heterogeneous. Thus, the model should be considered as a first-order approximation of the impacts of the two alternative development trajectories. As with any model, there are always opportunities for refinement, and it is recommended that the SAGCOT Centre and its partners continue to improve the model, based on new and additional data, so that becomes an ever-better decision support tool. Below are some key areas in which the model might be refined in future iterations.

First, due to the lack of experience with sustainable intensification in the Corridor, it is difficult to predict whether SAGCOT producers will experience changes in yields and ecosystem services comparable to those seen in other countries. As more data on the impacts of AGG become available from trials and initial implementation in different parts of the Corridor, these data may be used as input parameters. Second, the model does not consider the effects of shifting from a single harvest per year to two harvests per year under intensified irrigation agriculture. While this omission does not materially affect the relative

difference between the AGG and AIPP scenarios, it might affect the absolute numbers estimated for yield. Third, the model could incorporate additional modules to provide greater sensitivity to other production factors including the incidence of extreme weather events, crop rotation, and the relative productivity of different land classes under various production systems. Fourth, the lack of data on livestock production in the Corridor prevented us from being able to include credible calculations for that sector. Incorporating livestock in future versions would be helpful. Finally, economic calculations and livelihood impacts are absent from the model, although impacts may be inferred roughly from the yield estimates. Pairing the production projections with market projections could provide valuable insight into the economic impacts of AGG on the return on investment for large scale producers and on rural livelihoods for outgrowers and unaffiliated smallholders.

The development of the the SAGCOT Greenprint was led by the Green Growth Technical Team from EcoAgriculture Partners, reporting to the SAGCOT Centre and the Green Growth Reference Group.

About EcoAgriculture Partners

EcoAgriculture Partners is an international non-governmental organization that supports the integrated management of rural landscapes to simultaneously improve rural livelihoods, sustainably produce food and fiber, and conserve healthy ecosystems. The organization does so by providing training, research, policy solutions, and support to farmers, communities and organizations at the local, national and international levels.

Contact
Sara J. Scherr, President
sscherr@ecoagriculture.org

About the SAGCOT Centre

The SAGCOT Centre seeks to improve the economic performance of the Tanzanian agricultural sector and secure a place for Tanzania farmers in global value chains by coordinating, supporting and facilitating activities in the Southern Corridor and fostering an environment where innovation can thrive and dedicated leaders can make a real difference.

Contact
Jennifer Baarn, Deputy CEO
jennifer.baarn@sagcot.com

SAGCOT

SOUTHERN AGRICULTURAL GROWTH CORRIDOR OF TANZANIA

For more information: info@sagcot.com