AFRICA BIODIVERSITY COLLABORATIVE GROUP

Finding Optimal Trade-offs Between Food Security and Conservation in Africa:

A Review of Tools and Presentation of Case Studies from Zambezi and Ituri Landscapes

Report on ABCG/BATS Food Security Task

By

Jimmiel Mandima and Nasson Tembo, African Wildlife Foundation,
Bemmy Granados and Terry Hills, Conservation International and
Michael Painter and Robert Mwinyihali, Wildlife Conservation Society

ABCG's members are U.S.-based international conservation NGOs with field activities in Africa. ABCG's mission is to tackle complex and changing conservation challenges by catalyzing and strengthening collaboration, and bringing the best resources from across a continuum of conservation organizations to effectively and efficiently work toward a vision of an African continent where natural resources and biodiversity are securely conserved in balance with sustained human livelihoods.

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Africa Biodiversity Collaborative Group
4245 North Fairfax Drive
Suite 100
Arlington, VA
22203

The Africa Biodiversity Collaborative Group (ABCG) comprises the following seven international conservation NGOs:

- African Wildlife Foundation, 1400 Sixteenth • St, NW Suite 120, Washington DC, 20036
- Conservation International, 2011 Crystal Drive, Suite 500, Arlington, VA 22202
- the Jane Goodall Institute, 4245 North Fairfax Drive, Suite 600, Arlington VA 22203
- The Nature Conservancy, 4245 North Fairfax Drive, Suite 100, Arlington, VA 22203
- Wildlife Conservation Society, 2300 Southern Boulevard, Bronx NY 10460
- World Resources Institute, 10 G Street, NE Suite 800, Washington, DC 20002
- World Wildlife Fund – US, 1250 24th St., NW, Washington DC 20037

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EXECUTIVE SUMMARY

This report reviews the experiences and lessons learned on biodiversity conservation and food security from field-work and the collective expertise of the African Wildlife Foundation, Conservation International and the Wildlife Conservation Society, three organizational members of the Africa Biodiversity Collaborative Group (ABCG). ABCG comprises seven international conservation NGOs (African Wildlife Foundation, Conservation International, the Jane Goodall Institute, The Nature Conservancy, Wildlife Conservation Society, World Resources Institute, and World Wildlife Fund) with the goal of working collaboratively and efficiently, and effectively to further a sustainable future for the African continent. The objective of the food security and conservation working group is to develop an ***integrated set of foundation-year activities that will begin to allow enhanced understanding of the conditions necessary to improve food security, and improved on-farm adoption of biodiversity-sensitive intensification practices.***

To this end, the report discusses the findings of reciprocal visits that teams from African Wildlife Foundation (AWF) and Wildlife Conservation Society (WCS) made to field programs where efforts to improve farming practices play an important role in the conservation strategies of the two organizations. AWF and WCS are attempting to stabilize farming systems by increasing yields, labor productivity and income, through improved sustainable farming practices, and reducing pressures on families to expand their farms into forest areas and/or supplementing their incomes through practices like poaching and charcoal production. The two teams attempted to learn from their respective experiences, and bring a critical eye to what one another was doing, in an effort to make their respective efforts more effective.

To complement the field exercise, Conservation International (CI) conducted a review of the value of spatial planning and community engagement approaches in the context of 'lessons learned' from existing agricultural and rural development experiences in Africa. This analysis places particular attention on the capacity of such approaches to facilitate better management of tradeoffs and synergies between food security and conservation, and places the findings of the field visits in a broader context of experience gained in addressing similar issues in Africa as a whole.

The lessons learned and experiences shared suggest key issues that need to be considered to attain optimal trade-offs between food security and conservation in Africa, in the medium- to long-term. Lessons learned include: the need to be spatially explicit in agricultural and rural development planning, for which participatory land use planning is essential; the importance of being able to scale up activities to leverage tangible food security and conservation impacts at landscape scale; the strength that comes from building broadly-based partnerships that bring complementary expertise and resources; and the need to factor in the risks associated with shocks when external drivers may negatively affect years of investment, e.g. top-down political decisions to alienate land through large scale land acquisitions, commodity price fluctuations on the market, and extreme weather events (drought, floods, etc) that may force impoverished local people to resort to short-term survival strategies.

Together, the analysis of the field studies and the review of planning approaches contribute to the discussion of the relationship between ecosystem integrity and food security and generate findings and recommendations to guide next steps for ABCG and its members in the years to come.

1. INTRODUCTION

This report describes the experiences and lessons learned on biodiversity conservation and food security from field-work and the collective expertise of the African Wildlife Foundation, Conservation International and the Wildlife Conservation Society, three organizational members of the Africa Biodiversity Collaborative Group (ABCG). ABCG comprises seven international conservation non-government organizations (NGOs) (African Wildlife Foundation, Conservation International, the Jane Goodall Institute, The Nature Conservancy, Wildlife Conservation Society, World Resources Institute, and World Wildlife Fund-US) with the goal of working collaboratively and efficiently and effectively to further a sustainable future for the African continent. ABCG's mission is to tackle complex and changing conservation challenges by catalyzing and strengthening collaboration, and bringing the best resources from across a continuum of conservation organizations to effectively and efficiently work toward this vision of Africa.

With the support of USAID's Biodiversity Analysis and Technical Support (BATS) program, ABCG convened a group of African biodiversity experts to develop the Dar Vision on the Future of Biodiversity in Africa. Two key elements of the Dar Vision's logical framework are closely linked to ABCG's food security efforts:

1. **Harness biodiversity and ecosystem services for improved agriculture** including increasing productivity and yields and improving food security; and adopting conservation agriculture or "ecoagriculture" approaches.
2. **Refine landscape approaches** to natural resource management, using "matrix" approaches for the horizontal integration of activities; work within the landscape to understand the relationship between factors such as emerging infectious disease, food production, and environmental change, including especially climate change, changes in land use and land cover, and invasive species.

The objective of the food security and conservation working group is to develop an ***integrated set of foundation-year activities that will begin to allow enhanced understanding of the conditions necessary for sustainable agriculture intensification to improve food security, and improved on-farm uptake of biodiversity-sensitive intensification practices.***

ABCG members bring a wealth of expertise to examine the interactions of food security and biodiversity conservation efforts on the ground. **This report** examines existing and potential approaches that define current practice and seek to improve management of the information that informs project and planning decision-support tools, in order to maximize the value that can be realized through managing rural lands to promote multiple uses that include farming, ecosystem and wildlife management, and conservation. The observations and conclusions in this report may be helpful for conservation and development NGOs, government, local leaders and donors working on rural land use issues.

Following a short discussion on the relationship between ecosystems and food security in Africa, this report reviews the findings of reciprocal field studies that teams from AWF and WCS made to field programs where efforts to improve farming practices, and increase yields and labor productivity play an important role in the conservation strategies of the two organizations. The objective is to stabilize farming systems, by increasing yields, labor productivity and income, through improved sustainable

farming practices, and reducing pressures on families to expand their farms into forest areas, and/or supplement their incomes through practices like poaching and charcoal production. The two teams attempted to learn from one another's experiences, and bring a critical eye to what one another was doing, in an effort to make their respective efforts more effective. Field visits to AWF's Zambezi Heartland landscape, and WCS's Ituri Forest landscape were carried out in March 2011.

The report also includes a review by CI of the value of spatial planning and community engagement approaches in the context of 'lessons learned' from existing development experiences in Africa. This analysis places particular attention on the capacity of such approaches to facilitate better management of tradeoffs and synergies between food security and conservation, and serves as a foundation piece to guide next steps and tools for the ABCG Food Security (FS) Working Group moving forward.

This report recognizes that there are many different types of agricultural systems (and a wide range of associated nomenclature), but will focus on the approaches typically associated with conservation agriculture. In addition, this report will focus on smallholder producers in particular as the target agricultural sector and beneficiary group.

1.1 General Background

Poor rural people often have no choice but to improve their food security through extensive use of land; a common approach that reflects the desire of farming households to make the best use of limited resources to satisfy current needs, longer-term development aspirations, and reflects larger-scale landscape dynamics. In many situations such extensive land use results in encroachment into areas that are poorly suited to farming, but which contain important wildlife habitats, and/or play an essential role in the provision of ecosystem services upon which people and wildlife alike depend (e.g., the upper portions of watersheds that serve as water towers for both). In this context, the future of both poor rural people and wildlife may be tied to the development of new land use options, and understanding trade-offs and synergies between food security and conservation is essential for sound planning and management decisions. Unfortunately, in the absence of concrete proposals, and the means to implement them, incompatible land use often causes extensive damage to wildlife and their habitats, and over time often adds to the food insecurity experienced by vulnerable people.

From a development perspective, the circumstance of poor families trying to compensate for scarce capital and/or labor resources through extensive use of land that is not well suited for conventional farming is very rarely a long-term solution to food insecurity. Equally, land use that results in loss of soil fertility and overall degradation of ecosystem services is likely to provide only short-term gains. Opportunities for capital accumulation are likely to remain limited, and people are likely to find themselves in a "poverty trap," where they have resources that allow them to persist for extended periods of time, but are unable to improve their standard of living, and remain vulnerable to shocks. In this context, the introduction of capital and knowledge improvements that increase the productivity of land and labor may offer a means of constructing new livelihood options that benefit rural people, wildlife and the ecosystems. Such improvements may include the application of packages of improved inputs for crop production, the introduction of new cultivars, the introduction or improvement of livestock, and the introduction of technology and techniques to reduce losses of crops and livestock to wildlife. To the extent that people are able to increase farm yields and the productivity of their labor, in spaces zoned through community-led land use management agreements, the pressure to expand

farming activities into areas that are important wildlife habitats and sources of important ecosystem services may be reduced.

Greater food security, in conjunction with approaches such as participatory land use planning, may also reduce the pressure on people to sacrifice medium and long-term land management in order to satisfy immediate needs. Thus, if they do not need to occupy new areas to practice subsistence farming, hunt for bushmeat or poach, or cut down trees to make charcoal, to ensure that basic needs are met, conditions are more favorable for them to consider new land use options that require longer term management strategies and involve more complex organization (e.g., payments for ecosystem services (PES), ecotourism, sustainable forestry), but also offer greater potential for generating the resources that provide a pathway out of poverty.

However, our experience demonstrates that intensified agricultural production[1] does not by itself lead either to more secure livelihoods for the rural poor or new opportunities for biodiversity conservation. Issues related to benefit distribution, investment incentives, governance, land tenure and other factors can clearly lead to perverse outcomes from both food security and conservation perspectives. Therefore, it is important for local actors who use and manage land, government officers whose responsibilities include defining and regulating land ownership and use rights, and donors and non-governmental organizations seeking to promote sound land management, to understand the opportunities and risks associated with promoting improved farming practices as a tool that contributes to both more secure livelihoods for rural people and more effective conservation and management of wildlife and the ecosystems of which they are part.

1.2 Rationale and Approach

While the issues described above operate in many areas of the world, they have particular urgency in Africa, because large numbers of rural families must deal with chronic food insecurity. Their situation is likely to become more vulnerable in the years ahead because of variations in temperature and precipitation associated with climate change, uncertainty and volatility in many commodity markets and accelerating environmental degradation from unsustainable development activities. Thus, seeking to make farming systems more productive and robust, conserving the wildlife patrimony that generates considerable foreign exchange and investment, and protecting the integrity of the natural ecosystems upon which both depend, are important development objectives. Furthermore, pursuing these objectives so that they complement, rather than compete with, one another requires a better understanding of the linkages among them.

ABCG members can make important contributions to this discussion, as several have been actively promoting integrated approaches that seek to incorporate land use planning strategies for rural areas that contribute to improving the food security and livelihood options of rural people. These strategies promote the conservation of wildlife and natural ecosystems. ABCG and its members have also been active in facilitating dialogue and providing African partners, USAID field Missions and development

[1] Intensive agriculture refers to agricultural practices that produce high output per unit area, usually by intensive use of manure, agrochemicals, mechanization and so on (Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997).

organizations with lessons learned from field experience. This effort has become especially relevant in the context of USAID's Feed the Future (FTF) Initiative, where ABCG has worked with a coalition of conservation and development NGOs and government colleagues to develop concepts and indicators to ensure that efforts to increase agricultural production and productivity also contribute to the integrity of the ecosystems upon which farming systems depend.

To this end, AWF and WCS have conducted a review of their efforts to address food security and biodiversity conservation issues in two key landscapes, the Zambezi Heartland that straddles Zambia, Zimbabwe and Mozambique, where AWF has been working since 2002, and the Ituri Forest Landscape, in the northeastern Democratic Republic of Congo (DRC), where WCS has been working since the 1980s. Both landscapes are strongholds for unique assemblages of wildlife and key ecosystem services, whose survival depends on the success of current conservation efforts. They are also home to human populations that are among the poorest members of their respective national societies, whose prosperity depends on finding livelihood alternatives that allow them to become secure that their basic food needs will be met, and offer their children the chance to improve their quality of life through education and new productive opportunities.

In both areas, AWF and WCS are working closely with local people to increase yields and the productivity of farm labor, and reduce the pressure that people are placing on wildlife and natural ecosystems as they seek to satisfy basic livelihood needs. Both efforts show promising results in many areas, but also highlight the complex nature of the linkages between human production systems, biodiversity and ecosystem integrity. With support from USAID's Biodiversity Analysis and Technical Support (BATS) program, the two organizations conducted joint field visits to the two programs to assess what the two experiences can teach about the ways in which improving food security can contribute to conservation and the risks and limitations of promoting food security as a conservation tool, and identify best practices that can contribute to making efforts to construct optimal and synergistic situations where increased food security and biodiversity conservation objectives reinforce one another more effectively. The present report shares the results of this exercise.

To contribute to the objectives of this work, Conservation International has examined the spatial and community-based approaches that are commonly used in natural resource management planning and for which the conservation community has an extensive range of experience, which may be of value to the agriculture and rural development community in Africa. Specifically, the tools will be reviewed in their capacity to:

1. Understand and value ecosystem and food security relationships in the local context.
2. Identify areas where ecosystem and biodiversity management are critical constraints to long-term food security.
3. Identify areas where agricultural and rural development efforts are undermining long-term food security by degrading ecosystem services.
4. Inform the development of programs and collaborations that support improved ecosystem and biodiversity management to meet food security objectives.

To help guide and frame our work, the group has established a set of principles that allow the trade – offs between conservation and food security objectives to be optimized re:

A) Longer term food security is underpinned by good environmental management and biodiversity conservation.
B) In meeting shorter-term food security needs, ecosystem health is often unavoidably traded off - particularly in times of shock.
C) Supporting the introduction of more resilient agricultural systems for smallholders can improve the quality of these tradeoffs.

Figure 1 offers a simplified graphical representation of the different scenarios that can occur across a landscape in terms of conservation and food security outcomes, based on the definition of four quadrants. It should be noted that we recognize that land use is a very dynamic process, and over time and across space these conditions will change and vary – even moving from one quadrant to another. The objective of this graphic illustration is to depict the trade-offs and potential for synergies that can occur over time and space. Based on the logic of this illustration, interventions would be designed to 'push' practice towards the top right hand quadrant in a defined 'system' over a given period of time.

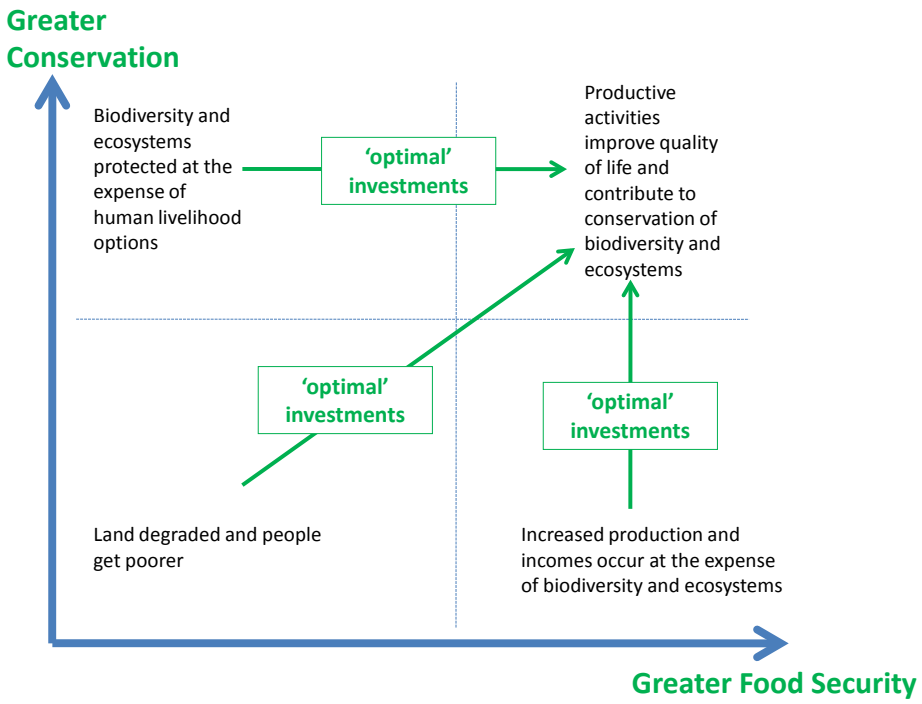

Figure 1 - Describing the Scenarios for Conservation and Food Security in a Landscape

2. FOOD SECURITY IN AFRICA

2.1 Introduction to Food Security

The UN Food and Agriculture Organization (FAO) defines food security as a *"situation that exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food that meets their dietary needs and food preferences for an active and healthy life".*

Food security is commonly described in terms of four components:

1. Availability: Is there **enough** appropriate, quality **food** to feed everyone in the system?

2. Access: Can everyone in the system **afford food**?
3. Stability: Is the supply of food **resistant to sudden shocks** or cyclical events?
4. Utilization: Is the food resulting in people having **sufficient nutrition** to be healthy and productive?

The production of food, therefore, is a necessary, but not a sufficient condition, to assure food security. Other critical elements for food security include nutrition, affordability, access to markets, sanitation and diversity of supply.

On the individual level, food insecurity can be manifested either as an overall lack of sufficient calories (malnourishment) or as a deficiency in nutrient intake (malnutrition). Both of these conditions can occur as a result of famine, usually linked to some sort of disaster or market shock, or they can occur chronically, over the long-term. Either way, the toll is significant: more than six million children under five die in developing countries each year from under-nutrition and hunger-related diseases—lack of vitamin A alone kills a million infants per year. Hunger does not have to result in death to be a crisis; chronic undernourishment and malnutrition have been shown to reduce economic productivity and increase vulnerability to disease significantly. In fact, UNICEF estimated the global cost of under-nutrition to national economic development at US$20-30 billion per year.

Governance, regulatory and policy regimes also help shape food security - including land tenure, agriculture, fisheries, trade, social and environmental policy. The figure below illustrates many inter-related factors affecting food security from the perspective of both consumption and utilization. The knowledge of the relative importance of these drivers is improving quickly; the most recent FAO State of Food Insecurity Report (October 2010) explores the role of protracted crises in food insecurity, and recommends specific approaches that can improve food security in this context. This helps to demonstrate the importance of taking a diagnostic approach to food security interventions – addressing the local drivers of food security rather than having a strategy that seeks a 'silver bullet'.

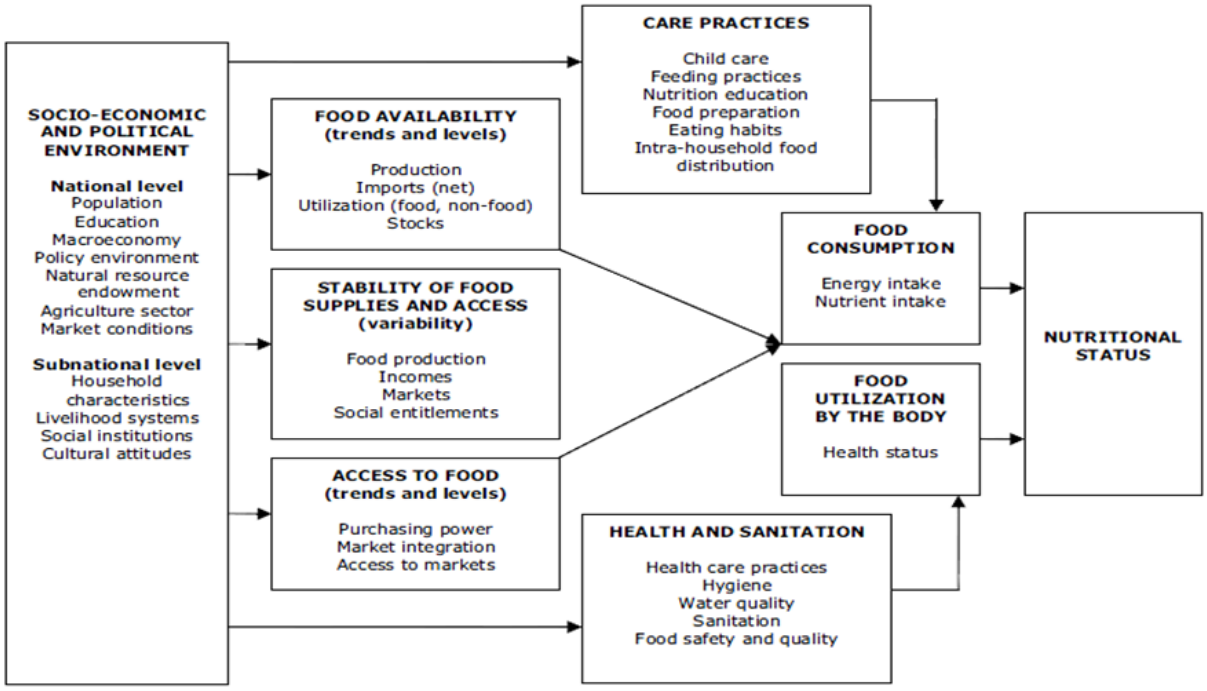

Figure 2 - Conceptual Framework for Causes of Food Insecurity (FAO, 2000)

2.2 Key Food Security Challenges in Africa

There are a number of drivers of food insecurity in Africa, and given the diverse contexts across the continent, it is difficult to generalize about the drivers and the significance of the contribution of healthy ecosystems to food and related human well being. Annex 1 describes the various factors contributing to Food Security in Africa as described from a UN study in 2008, separating the issues of the different forms of capital from external factors and the availability of food. The two natural capital issues the study describes are mono-cropping (as it is less resilient to stresses) and degraded natural resources (and their capacity to in turn compromise food production) (UNEP/UNCTAD (2008).

From the range of issues presented in the Annex it is clear that in the African context the relationship between natural resource-derived household incomes in rural areas and food security is very strong. One illustration of this is through examination of challenges to income from livestock. Across Africa, livestock play multiple roles in many rural households – as a source of milk and meat, income generation, fertilizer, draught power, and as a living "bank" for storing assets over time.

2.3 Food Security, Poverty and Agriculture and Rural Development in Africa

The relationship between agriculture, poverty and food security is strong but varied and complex in the African context. However, one recurring theme is that agriculture is considered to be a major driver of rural economic development (and hence poverty reduction) in Africa. According to ActionAid (2010):

> *Recent research shows that growth in agriculture can make twice the impact on poverty as growth in other sectors, both through its direct impact on raising the incomes of the large numbers of the poor who*

live in rural areas, and through the strong links between agriculture and other parts of the economy. If, for example, Malawi achieves the African Union target of 6 per cent annual growth in agriculture, an additional two million Malawians will be living above the poverty line in 2015.

It can be demonstrated that where economic growth has improved, it has reduced poverty in Africa. Many development agencies active in Africa go further than this and argue that it is only where agricultural growth has increased that hunger has been reduced in Africa (AusAID, 2008). This theme is further elaborated as follows:

> *Accelerating the rate of broad-based agricultural growth increases food security in several ways. First, it increases food availability and reduces the price of non-tradable or semi-tradable food. Second, broad-based agricultural growth is the most powerful way to reduce rural poverty (WDR 2008). More specifically it increases food availability for, and access to those able to produce it for themselves. It also improves the incomes of small farmers and agricultural workers who are net food buyers. Third, through forward, backwards and consumer-demand linkages it increases non-farm economic activity in rural areas that tend to be highly labour intensive, and creates significant employment and incomes for the rural poor. Through similar linkages it also increases urban employment so that agricultural growth generally has a greater poverty reduction impact than urban growth (WDR 2008).*
>
> *However, not all forms of agricultural growth have such beneficial impacts on food security. For example, the expansion of a large-scale mechanised farm sector that produces raw materials for biofuels or industrial raw materials could have overall growth benefits. But it would not increase national food availability or reduce national food price levels. It is also not sufficiently employment intensive to increase the purchasing power for food of many poor people. Only where such commodities are produced by smallholders using more labour-intensive methods and spending a high share of income on labour-intensive rural home goods will significant food access benefits occur.*

It is noteworthy that the role of agricultural development in reducing rural poverty is also central to the U.S. government's Global Hunger and Food Security Strategy (Box 1).

Box 1 - The US Government's Global Hunger and Food Security Strategy

The USG has over many decades prioritized and invested in initiatives that address food production and food security. These programs have evolved over time in response to the growing need to address the global food insecurity. The Feed the Future Presidential Initiative is led by USAID and leverages the strengths across different U.S. government agencies. FTF focuses on supporting country-driven approaches to address the root causes of hunger and poverty. FTF is investing in 20 focus countries (12 of which are in Africa) to transform their agricultural sectors to grow enough food sustainably to feed and provide nutritional outcomes for their people. Some of the major attributes of this initiative include the facilitation of farmer to market linkages locally to globally, mobilization of the private sector, civil society and multilateral institutions; agricultural-led growth that reduces undernutrition; and robust monitoring and evaluation systems. The conservation and development communities have been engaging positively with the Bureau of Food Security on the integration of natural resource management and climate change in FTF. ABCG FS work represents an opportunity to provide complementary examples and inform such integration for joint food security and environmental outcomes at the land and seascape scale.

Based on these arguments, a focus on smallholder rural development is appropriate for this ABCG work; improving agricultural performance with a lower ecosystem 'footprint' as a mechanism to improve long-term food security.

However, one of the key lessons from the history of large-scale agricultural and rural development (ARD) initiatives is that yields can only be improved over limited time frames[2], and at the expense of biodiversity and ecosystem health[3]. The Green Revolution focused primarily on raising the yields of two staple crops: rice and wheat, but Africa's diverse agro-ecological zones and varied conditions will require a much greater range of approaches, from boosting productivity in a wider range of crops, including millet, sorghum, and cassava, to developing crops that are resistant to drought, disease, and pests.

2.4 The Varied Farming Systems of Africa

The farming systems across the countries of Africa are extremely diverse, and there are significant challenges in proposing interventions that are suited to such varied physical, social and economic circumstances. However, a broad-scale categorization of farming systems is necessary to begin the process of ARD planning. One of the most commonly accepted breakdowns of distribution of farming systems in Africa is from Dixon (2001), which proposes 14 different farming systems, as shown in Figure 3. These systems range from irrigated, forest-based, pastoral to coastal artisanal fishing.

Clearly, the delineation of these areas is only indicative, as a much more diverse range of systems that accommodate a wider range of technological and process options exist on the ground. However, as a starting point for further investigation, each of these systems carries a core set of dependencies and risks related to biodiversity and ecosystem services. For example, looking at just one of these systems (pastoral), the potential environmental impacts of the livestock sector typically include deforestation, desertification, soil degradation, high water use and water pollution (including from animal wastes and sediments from eroded pastures)(FAO, 2006a). The production and yield losses generated by these problems in the livestock sector have a significant long-term effect on the welfare of the poor. For example, the encroachment of invasive species into Ethiopian rangelands, along with recurrent and increasingly severe drought, has caused more frequent and catastrophic crashes in livestock populations, forcing many poorer families out of livestock herding altogether (Desta and Coppock, 2002).

[2] *After more than doubling from 1.25% annual growth in the 1970's to 2.69 annual growth in the 1980's as a result of Green Revolution productivity gains, Asia rice yields have declined to a 0.94% annual growth rate since 1990, and only 0.8% annual growth over the most recent decade, 1998-2007 (*International Rice Research Institute - 2009)

[3] The environmental 'price to pay' for the Green Revolution included *"contamination of groundwaters, release of greenhouse gases, loss of crop genetic diversity and eutrophication of rivers, streams, lakes and coastal marine ecosystems (contamination by organic and inorganic nutrients that cause oxygen depletion, spread of toxic species and changes in the structure of aquatic food webs"* (Tillman - 1998)

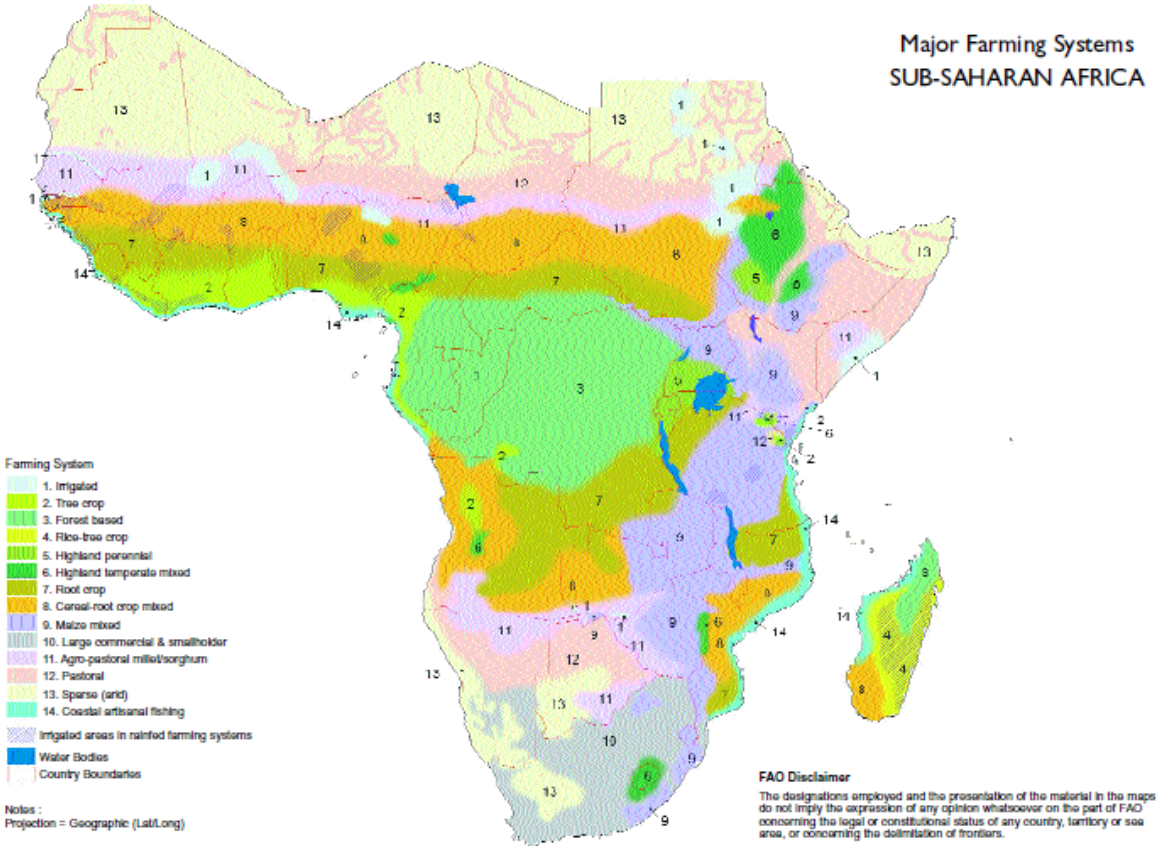

Figure 3 - Farming Systems in Sub-Saharan Africa (Dixon, 2001)

2.5 Linking Food Security and Ecosystem Trends in Africa

As described above, there are many drivers of food insecurity that combine in different ways to result in a very specific set of local vulnerabilities. In order to appreciate the relative importance of ecosystems and biodiversity in this mix of drivers, it is useful to first examine the geographic relationship between food security (and its flux) and ecosystem service state (and its flux) in the African nations. It should be noted that using such national data is problematic for two reasons. Firstly, it can be unreliable, and secondly, it suggests a misleading homogeneity within the countries being compared; sub-national pockets of food insecurity may be invisible to such studies. This challenge becomes magnified in landscapes where ecosystem health has a transboundary and regional dimension that needs to be incorporated in linking food security to ecosystem trends. It is thus important to be spatially explicit in defining the scale of operation that is guided by best available and harmonized data sets to generate tangible, sustainable conservation and food security outcomes. This enables setting clear contexts for which actions are taken and how they are measured.

Annex 2 describes and compares some of the national-level food security and ecosystem data in Africa. Based on the information presented it is difficult to measure and observe at such a scale the dynamic relationship between ecosystem health and food security. Since many ecosystem service benefits (notably excluding carbon sequestration) are locally manifested (i.e. water quality and quantity, pollination, etc.) there may be substantial sub-national landscapes in which ecosystem services play a core role in maintaining food security, and the underlying stability essential for long-term food security. Hence, it is important to be able to identify these contexts to develop programs and collaborations that capitalize on the conservation of these services. One of the best ways to understand how relationships and tradeoffs may play out in different sub-national contexts is through the detailed exploration of case studies.

2.6 The Menu of Conservation Agriculture Approaches

In recent years the number of agricultural approaches that have attempted to increase the alignment of agricultural and conservation objectives has steadily increased. All such approaches distinguish themselves clearly against conventional agricultural practice[4], but there is significant overlap between the various approaches as well as clear distinctions (Table 1). For the purposes of this report, we will be referring to Conservation Agriculture (CA) specifically. This is with the recognition that from the field perspective this approach shares much in common with other approaches described in the tables. Indeed, in reality we also integrate a mix of other like approaches as appropriate (as an example, ecoagriculture).

[4] For purposes of this report are defined as any type of farming system relying on practices popularized during the green revolution that is not certified organic, including methods ranging from low input, rain fed cultivation; to intensive, irrigated specialty cropping; to greenhouse production.

Table 1- Integrated Agriculture Approaches that Support Optimal Synergies

Approach	Definition and Source
Conservation Agriculture	*An array of practices which at its core are three interlinked principles that can be applied in a variety of combinations to meet the needs of resource poor farmers:* • *continuous minimal mechanical soil disturbance,* • *permanent organic soil cover,* • *diversified crop rotations of annual crops and plant associations of perennial crops.* *Conservation agriculture is more than a zero-tillage-based cropping system. Farmers following the CA principles use low-cost tools and equipment and traditional crop varieties without herbicides or herbicide-tolerant varieties.* (FAO - 2009)
Conservation Farming	*A system of using the land within its long-term capacity. The aim is to conserve the soil, water, fauna and flora of the land, while reaping social and economic benefits from it* (Roberts - 1994)
Ecoagriculture	*A vision of rural communities managing their resources to jointly achieve three broad goals at a landscape scale:* • *Enhance rural livelihoods;* • *Conserve or enhance biodiversity and ecosystem services; and* • *Develop more sustainable and productive agricultural systems.* *Ecoagriculture is both a conservation strategy and a rural development strategy and recognizes agricultural producers and communities as key stewards of ecosystems and biodiversity and enables them to play those roles effectively. Ecoagriculture applies an integrated ecosystem approach to agricultural landscapes to address all three pillars, drawing on diverse elements of production and conservation management systems. Meeting the goals of ecoagriculture usually requires collaboration or coordination between diverse stakeholders who are collectively responsible for managing key components of a landscape* (Sara Scherr and Jeffrey McNeely - 2000).
Evergreen Agriculture	An approach in which trees are intercropped in annual food crop and livestock systems and within which a green cover is sustained on the land throughout the year. It bolsters nutrient supply through nitrogen fixation and nutrient cycling, and increases direct production of food, fodder, fuel, fibre and income from products produced by the trees. Trees on farms also increase resilience to climate variability and climate change. (World Agroforestry Centre - 2011)
Greening Agriculture	*The increased use of farming practices and technologies that simultaneously:* • *Maintains and increases farm productivity and profitability while ensuring the provision of food on a sustainable basis* • *Reduce negative externalities and gradually lead into positive ones* • *Rebuild ecological resources by reducing pollution and using resources more efficiently (UNEP - 2011)*
Organic Agriculture	*Organic agriculture is a holistic production management system which promotes and enhances agro-ecosystem health, including biodiversity, biological cycles, and soil biological activity. It emphasizes the use of management practices in preference to the use of off-farm inputs, taking into account that regional conditions require locally adapted systems. This is accomplished by using, where possible, agronomic, biological, and mechanical methods, as opposed to using* *synthetic materials, to fulfill any specific function within the system (*Kristiansen, P. Taji, A. & Reganold, J. - 2006)
Sustainable Agricultural Development	The management and conservation of the natural resource base, and the orientation of technological and institutional change in such a manner as to ensure the attainment and continued satisfaction of human needs for present and future generations. Such development... conserves land, water, plant and animal genetic resources, is environmentally non-degrading, technically appropriate, economically viable and socially acceptable. (FAO - 2000)
Sustainable Agricultural Intensification	*Sustainable agricultural intensification is defined as producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services* (Royal Society, 2009; Godfray et al - 2010)
Sustainable Land Management	A knowledge-based procedure that helps integrate land, water, biodiversity and environmental management to (including input and output externalities) meet rising food and fiber demands while sustaining ecosystem services and livelihoods (World Bank - 2006)

There are many examples of high productivity and increased production stability associated with these approaches. Pretty (2006) showed average yield increases of nearly 80% as a result of farmers in 57 poor countries adopting 286 'best practice' initiatives. In relation to organic agriculture, there are also examples of increased profitability (in terms of net farm income earnings) with UNEP/UNCTAD (2008), noting that certified organic farms in East Africa involved in production for export were "significantly more profitable" than those involved in conventional production.

It should be noted that these approaches are not the panacea to securing yield increases. However, one clear advantage of these approaches is that they are less vulnerable to exogenous shocks, such as changes in farm input prices. For example, one of the most commonly used sources of nutrients in developing countries is diammonium phosphate (DAP). The price of DAP rose six-fold in early 2008 due to the energy prices involved in the production of the ammonium, and because of the shortages in both sulphur and phosphate (Conway et al, 2010). Use of CA techniques will enable production to be maintained despite such fluctuations.

3. DESCRIPTION OF THE CASE STUDIES

3.1 WCS' Ituri Landscape

The Ituri Landscape in northeastern Democratic Republic of Congo (DRC) covers 40,806 km^2 and is the largest most intact rainforest block in the eastern Congo Basin (Figure 4). Ituri hosts extraordinary biodiversity including 90 species of mammals, 333 species of birds, over 500 species of butterflies and over 2,500 species of plants, including:

- The largest population of okapi, a forest giraffe, endemic to DRC (7,000 to 10,000).
- The highest number of primate species (17) recorded in one area in Africa.
- The largest population of forest elephants remaining in DRC (3,000-5,000).
- An important population of chimpanzees (11,000).
- An array of forest antelope species (10), 2 species of forest pigs, and the forest buffalo.
- More than 75 commercial timber species

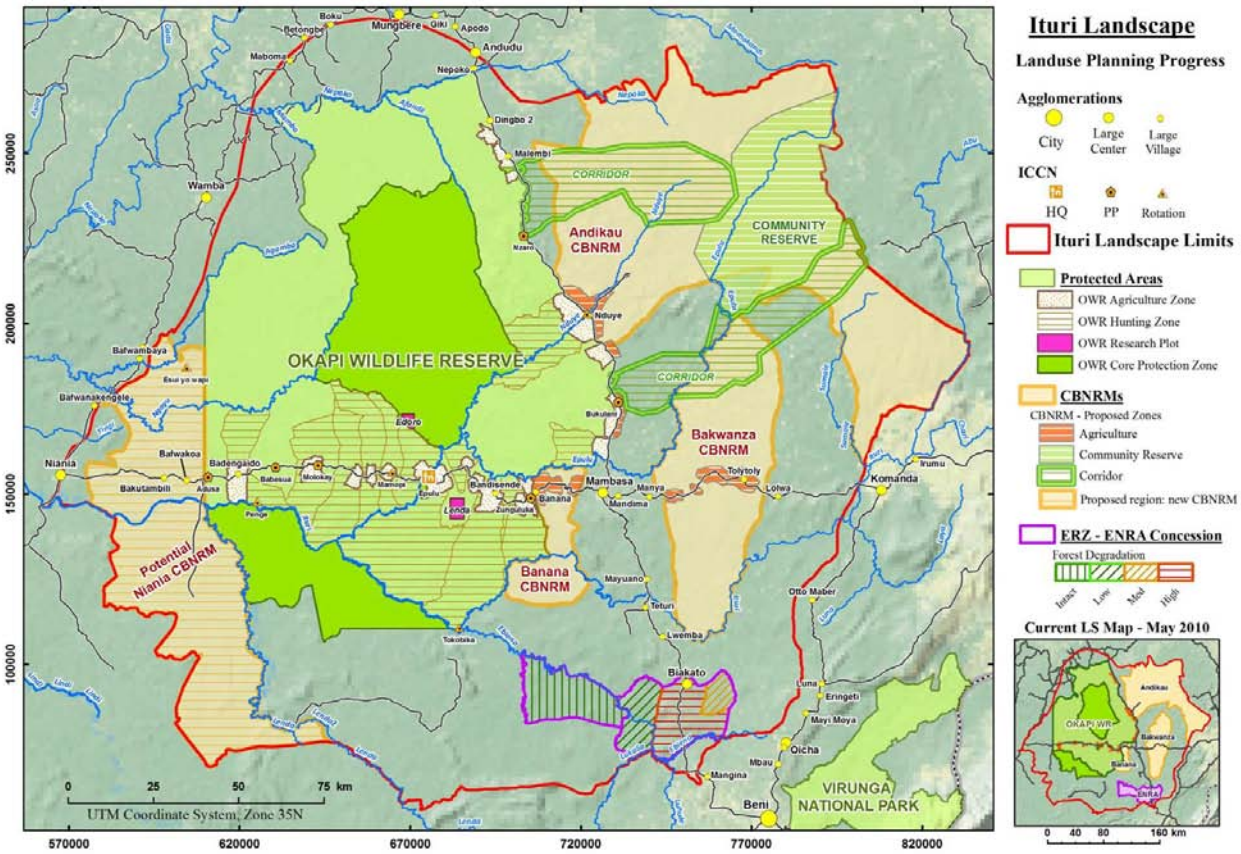

Figure 4 – Map of Ituri Landscape

Ituri is home to approximately 300,000 people that occupy the landscape and its immediate surroundings and this includes the largest remaining 30,000 strong population of the hunter-gatherer Mbuti Pygmies. Located on a settlement frontier, the landscape is increasingly under threat due to an influx of immigrants from densely populated surrounding areas and human activities, including slash-and-burn agriculture, logging, ivory poaching, commercial bush meat hunting and artisanal mining. Because there are very few options for employment, most people rely on their farms and the forest for all of their dietary, household and economic needs. Thus the health of local communities is intricately linked to the health of the landscape. Projected population growth and expansion due to immigration into the region are expected to lead to higher rates of forest conversion and concomitant pressure on natural resources. Experiences in working with local people to stabilize production systems and reduce forest loss are discussed in detail in Brown (2009).

Livelihood activities are conducted in the four macro-zones of the landscape defined by the actual land use planning process supported by the Congo Basin Forest Partnership (CBFP) and USAID's Central African Regional Program for the Environment (CARPE). These macro-zones are the Okapi Wildlife Reserve (OWR; within the agriculture zones) and three Community-Based Natural Resource Management (CBNRM) areas, namely Bakwanza (2,861 km^2), Banana (575 km^2) and Andikau (6,000 km^2).

Activities are conducted by two WCS partners, Pact and Gilman International Conservation (GIC). In the Okapi Wildlife Reserve, WCS and GIC are working with individual households in food crop production, and with local associations in implementation of small grant projects that promote alternative economic activities (animal husbandry, fish husbandry, microenterprises, etc). Outside the OWR, WCS works with individual livelihoods to promote food crop production and agroforestry as well as small grant projects with local associations to develop alternative economic activities. Pact is promoting food crop production through a local association and literacy program with women's groups in all three CBNRMs.
Livelihood activities carried out by WCS and its partners include:

- Raising awareness of alternative livelihood options and improved NRM practices.
- Developing alternative livelihoods that will raise household income, reduce poverty and improve food security through food crop production, agroforestry and small grant projects.
- Building capacity of local organizations, governance structures and women (literacy, microenterprise, saving).

WCS' vision in the Ituri Landscape is to conserve forest ecosystems and the biodiversity, to preserve its cultural values and to support the livelihoods of local communities living within its limits. The objective pursued by WCS in the Ituri landscape is to preserve its unique biodiversity and to ensure a balanced use of the natural resources. This will be achieved through:

- Increased populations of elephant, okapi and chimpanzee and reduced poaching.
- Sustainable hunting of duikers across the landscape.
- Conserved and well-managed forest ecosystems and habitats.
- Equitable governance of natural resource use achieved.
- Long-term survival of Mbuti populations ensured and their traditional rights secured.
- Achieved community managed forests with a significantly larger number of local populations benefiting from sustainably managing forests.

In relation with livelihood activities conducted in the landscape the goal pursued by WCS is to improve household income by investing in economically sustainable alternative livelihood activities that mitigate negative environmental impacts of current practices, particularly farming and uncontrolled small-scale timber exploitation, unsustainable hunting and to improve natural resource management.

3.2 AWF's Zambezi Heartland

AWF's Zambezi Heartland is a three-country (Zimbabwe, Mozambique and Zambia) transboundary landscape along the middle stretch of the Zambezi River between Kariba and Cahora Bassa Dams, covering an area of approximately 47,000 km^2 (Figure 5). Apart from the Zambezi, two other major rivers, the Kafue and Luangwa, transect the Heartland in Zambia. The Heartland is typified by extended riverine habitat that hosts over 36,000 elephants and in terms of biodiversity richness, the protected wildlife areas in the Heartland have some of the most breathtaking and outstanding terrestrial and riverine wildlife viewing and scenic landscapes in Southern Africa. The total human population resident in the heartland is approximately 560,000, the majority of whom derive their livelihoods from subsistence agriculture and livestock husbandry. Because of the nature of these livelihood economic activities, the ecological landscape is threatened by land degradation as a result of forest removal for agriculture, construction timber and fuel, high livestock densities (especially goats) and bush fires set by poachers. The landscape has three broad land tenure systems: communal areas, state and privately

owned land, each of which is subject to different and sometimes conflicting land uses and governance regimes that result in serious threats to biodiversity conservation. Human-wildlife conflict is prevalent in the communal areas and Game Management Areas (GMAs) because wildlife, especially elephants, damage crops and threaten the food security and livelihoods of communal people.

AWF has worked in the Heartland since 2002 and the Conservation Agriculture (CA) work that forms the base for this study was conducted as one of the main objectives to introduce and implement improved agricultural practices as part of AWF's Wildlife, Environment and Agriculture for improved Livelihoods in a Transboundary Heartland (WEALTH) project implemented over 2.5 years with funding from the Swiss Agency for Development and Cooperation (SDC).

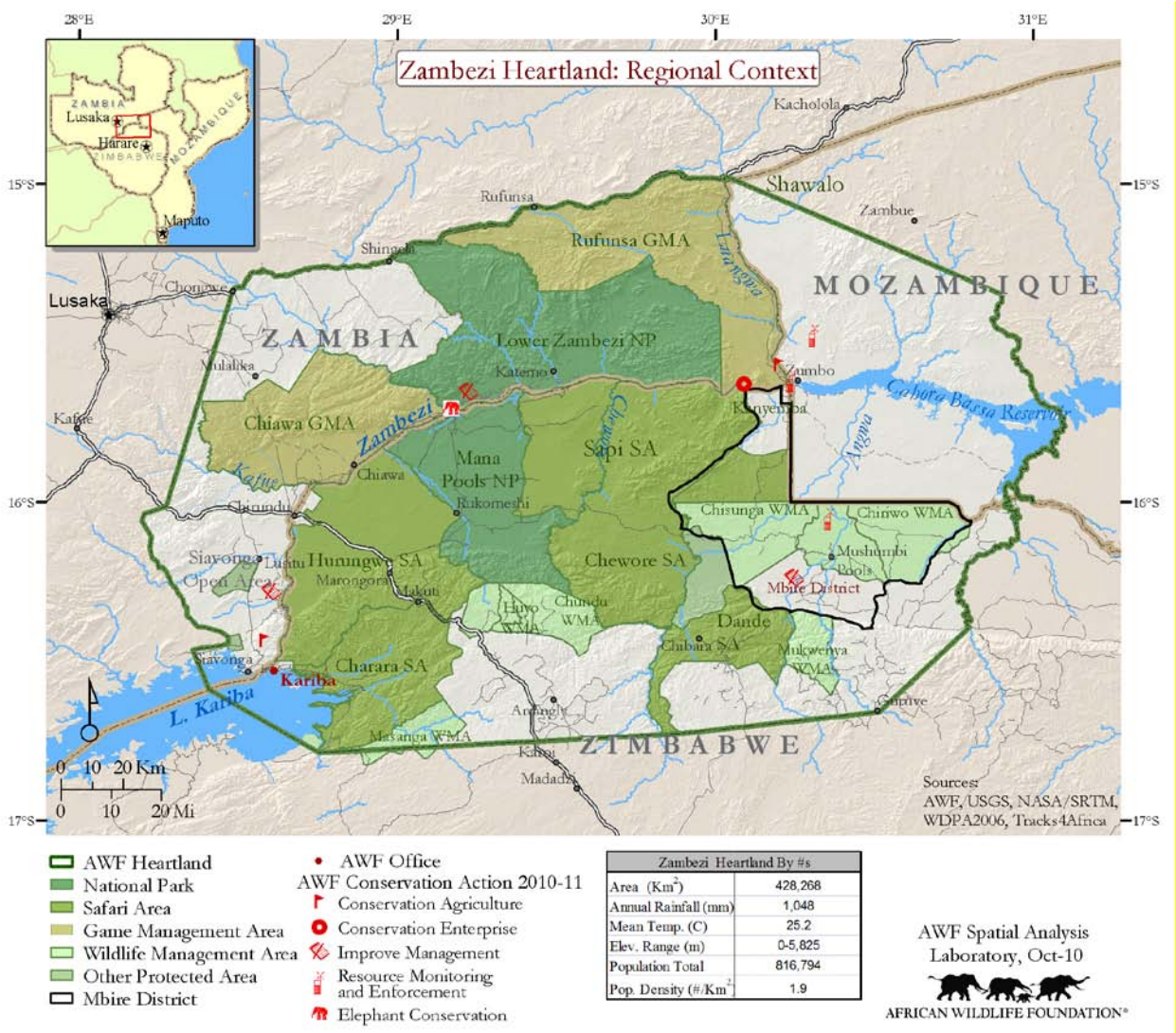

Figure 5 – Map of Zambezi Heartland

The reasons for engaging in CA in Siavonga and Luangwa districts were based on the following observations:

- **Unsustainable land use practices**: There is significant and rapid expansion of agriculture to produce maize in areas where neither the soils nor the climate are suitable. Consequently, yields are erratic and decline over time as the agricultural practices are not sustainable and deplete the soil nutrients. This has led to pressure to clear more land resulting in 'shifting cultivation'. Stream bank cultivation has caused land degradation and sedimentation of the rivers and streams which negatively affects the quality of water and performance of other aquatic resources in the rivers.
- **Lack of diversified livelihood options**: Local communities depend on traditional subsistence agriculture and, along the rivers, subsistence fishing as the main livelihoods options. There is a general lack of formal participation by the local population in economic activities that tap into other natural resources such as the abundant wildlife through ecotourism and commercialization of non-timber forestry products (NTFP) like honey, wild fruits etc.
- **Human-wildlife conflicts**: Due to lack of direct tangible benefits accruing from wildlife through tourism to most of the population, wildlife is not welcome as it causes damage to crops, and injury or loss of lives to people and livestock. This conflict and animosity grows as people open up new areas for cultivation, in the process shrinking the dispersal area for wildlife while not necessarily improving any crop production gains.

The CA techniques are an adaptive set of cost and labor effective tools that improve use of the available farming resources, in particular the soil and the soil moisture while exploiting the benefits of suitable crops and livestock.

AWF's goal for work in Zambezi landscape is to improve the integrity of biological diversity through improved land and habitat management that addresses food security and livelihood issues for which conservation agriculture is one option in those zones considered appropriate.

4. MAJOR FINDINGS

This section provides highlights of the implementation experience and performance of CA across the two case studies, in AWF's Zambezi Heartland and WCS's Ituri landscape. Results show broad variation in terms of application and outputs of CA. While there are many factors affecting how effective efforts to support conservation goals by improving farming systems are, our findings fall into four major areas: (1) the importance of a participatory spatially explicit approach, (2) the need for clear conservation and food security objectives, (3) the importance of coordinated partnerships and (4) the need to combine intense sustained work with farmers with efforts to address issues beyond the farm level, such as market linkages and policy.

4.1. Importance of a Spatially Explicit Approach

It is essential to be clear about the spaces we propose to dedicate to different kinds of land use, in order to understand the trade-offs that arise from different combinations of activities, and who reaps the benefits and who pays the costs associated with promoting one set of options over another. In the end, the objective is to construct a mosaic of land uses that optimizes the value that can be realized from different types of land use over the long-term. In principle, these uses should be mutually reinforcing, with the conservation of biodiversity and ecosystem integrity contributing to rural livelihoods, by ensuring that production systems are resilient in the face of ecological and economic shocks and

providing income-generating opportunities that complement crop production and animal husbandry. In practice, local people and decision-makers are confronted with a series of tradeoffs that reflect different visions of how land should be used, and the challenge is to address those tradeoffs transparently, and in a way that optimizes production outcomes and promotes the integrity of ecosystems.

In both Zambezi and Ituri, poor rural people are encroaching on areas that are sources of critical ecosystem services that benefit people (e.g., moderation of variations in temperature and rainfall, flood control, water provision) and critical habitat for wildlife. This reflects a combination of factors, including declines in soil fertility, changes in temperature and rainfall, unfavorable market conditions and increasing subsistence costs for rural families, among many others. By farming larger areas, people attempt to increase production enough to offset these difficulties. While understandable in light of the limited options available to them, this strategy is self-defeating for a number of reasons. Many of the areas that families have occupied are not well suited for farming, and will never be competitive with other areas that are better endowed with characteristics that favor agriculture. By encroaching on wildlife habitats, farmers make themselves more vulnerable to problems like crop raiding, and distance themselves from roads, markets and urban services (e.g., improved inputs, credit, education, health care). Furthermore, by degrading natural ecosystems and reducing wildlife populations, they may be undermining medium-term development options that could yield them greater returns than farming (e.g., community-based tourism, sustainable forestry), and undermining the integrity of the ecosystems upon which long-term farming success depends, in order to satisfy short-term needs.

In the face of this problem, AWF, in Zambezi, and WCS, in Ituri, seek to stabilize production systems by helping people increase the returns to land and labor, and reduce vulnerability in the face of threats associated with changes in temperature and precipitation, crop raiding and diseases that affect crops, livestock and people. In the case of the Ituri landscape, support for improved input packages in the Okapi Wildlife Reserve follows on an extended participatory land use planning process that reached agreements on defined zones for farming, hunting, and conservation (Brown 2009). Concentrating agriculture in the farming zones consolidates people's rights to farm and hunt in the Reserve, reduces crop losses from wildlife, makes it easier for people to collaborate on productive activities that they might not be able to undertake as individual families working alone in dispersed plots, and improves access to technical support and transport. Reduced encroachment from farming also allows the hunting zones to be more productive. WCS support for improved input packages is intended to help people build on these advantages to consolidate successful and resilient farming systems in the agricultural zones, and ensure that the pressures that have driven encroachment into forested areas do not recur.

Similarly, AWF has worked with Zambia's Ministry of Livestock and Fisheries, Ministry of Agriculture and Cooperatives, and the Golden Valley Agricultural Research Trust (GART) to provide improved livestock and crop inputs to increase yields and allow family labor to be more productive in areas that have already been degraded. AWF and its partners also work with farmers to adopt measures to reduce losses to predation and crop raiding by wildlife, including shelters and corrals for goats and chili pepper treatments to discourage elephants. In contrast to the situation in Ituri, the areas for agriculture were not defined by a formal participatory planning process, but reflect responses to changing conditions that were not informed by a larger landscape vision. In some cases, local people and their chiefs responded to threats and opportunities as they presented themselves over the years, and, in the case of Siavonga District, some of the farmers were moved to their present location by the national government to make way for the Kariba Dam. In this context, AWF is focusing on stabilizing production in areas that have been degraded, and expects to see conservation impacts as improved practices reduce pressures on

people to move into new areas. However, the absence of a participatory planning process means that they must make the best of the existing situation, and that many opportunities to optimize benefits to people as well as to wildlife have been lost. It is for this reason that AWF is simultaneously implementing PLUP in the Zambezi Heartland to rationalize use of land for agriculture and biodiversity conservation respectively. The planning approach being followed makes every effort to be informed by the critical elements needed for a spatially explicit approach as outlined below (Table 2).

Table 2 - Critical elements of a spatially explicit approach: observations from the case studies

- Participatory resource mapping by local communities and all other relevant public and traditional authority stakeholders
- Analysis of resource distribution and respective utilization over time
- Detailed socioeconomic analysis of settlement trends, patterns and distribution
- Assessment of existing food security strategies and ranking of the role of crop cultivation, livestock, fisheries and others (e.g. NTFP, crop and livestock wild relatives)
- Document land tenure systems and analyze resource use rights to inform implications of zoning
- Overall assessment of staple foods, crop varieties and livestock types that suit the area

4.2 Need for Clear conservation Objectives that Promote Production

The quest to improve food security through sustainable agricultural intensification in designated sites within a landscape needs to be paralleled by clear conservation logic. The ABCG Food Security Working Group recognizes that CA has to integrate three goals of environmental impact, social and economic equity. The CA approaches implemented in these sites attempted to have a '**systems perspective'** envisioned in its broadest sense, from the individual farm, to the local ecosystem, ***and*** to communities affected by this farming system both locally and globally in the context of climate change. This emphasis on the system allows a larger and more thorough view of the consequences of farming practices on both human communities and the environment. Such an approach gives us the tools to explore the interconnections between farming and other environmental aspects. There is limited awareness on the value of natural capital for providing ecosystem services and how agriculture practices that enhance functionality of ecosystems are essential.

The majority of the local communities in the WCS and AWF case study sites are not accustomed to relying on harvest of natural products as a key element of their livelihood strategies. Harvesting natural products was limited to periodic *ad hoc* collection or extraction of NTFP, and wildlife and fishing for household consumption. The main traditional way of life remains crop cultivation and/or livestock production, with the latter usually as a status symbol for wealth and safety net in emergencies. These systems have over the years continued to need more space as the human population grows and existing fields get degraded, hence increasing demand for land conversion for agriculture. This finding renders it imperative to articulate the full benefits of biodiversity conservation and how that links to more innovative forms of agriculture (i.e. integrated crop and livestock agriculture) and ensuring improved and sustained food security and local community livelihoods so that farmers value the 'big picture'.

The existing local knowledge on the value of conservation is embedded in the cultural beliefs, designation of sacred sites and places, etc. As such, it is important to engage communities and embrace the indigenous knowledge systems that have always included aspects of conserving culture and managing natural resources. This should subsequently be linked to modern science on ecosystem function, the role of forests to safeguard land degradation and in the water cycle. There is a dire need to highlight the key aspects in a landscape that demonstrate the interdependence of farming systems and ecosystem health so that the target communities can better participate and utilize planning tools, and employ appropriate selected crop and livestock varieties and CA technologies that seek to enhance soil fertility and reduce degradation. There is need to articulate the conservation imperatives that showcase the importance of linkages between farming systems and ecosystem health as outlined below (Table 3).

Table 3 - Conservation imperatives behind sustainable agriculture systems in the sites studied

- Water is a principal resource that helps agriculture and society to advance, and in semi-dry areas of Zambezi Heartland, can be a major limiting factor when mismanaged. It is essential to regulate its supply & use through 1) improving water conservation and storage measures, 2) promoting use of drought-tolerant crop species, 3) using reduced-volume irrigation systems (where applicable), and 4) managing crops to reduce water loss.
- Conventional agriculture affects water resources through deforestation and the destruction of riparian habitats within watersheds and the conversion of wild habitat to agricultural land, reducing fish and wildlife through erosion and sedimentation and altering the hydrological cycle regulated by forests enhancing the risk of flash floods and soil erosion and reducing the charge of groundwater aquifers. The plant diversity in and around both riparian and agricultural areas should be maintained in order to support a diversity of wildlife. This diversity enhances natural ecosystems and could aid in agricultural pest management.
- Soil erosion is a serious threat to the ability to produce adequate food; as such, numerous practices need to be applied to reduce erosion, including reducing or zero tillage, managing irrigation to reduce runoff, and keeping the soil covered with plants or mulch. Enhancement of soil quality is also done through crop rotation and intercropping to enhance soil fertility.
- Conventional agriculture is among the principal sources of deforestation, degradation and loss of biodiversity. It has an

4.3 Role of Partnerships

The role of multiple partners is pivotal for conservation success at a landscape level, because partners bring complementary expertise, resources and mandates that all contribute to successful implementation of actions. In the case of work in Zambezi and Ituri, both AWF and WCS enlisted the direct involvement of public, traditional, NGO and community-based institutions to implement actions that would result in conservation leverage. Government provides and oversees the policy arena of actions implemented and through its technical agencies, works with a diversity of other implementing partners to get work done. This approach has value in ensuring that the right skill sets are brought together for a common goal and also result in efficient resource use, while also avoiding duplication.

4.3.1 Government

Government's role is to develop policy and direct implementation of programs that conform to National Development Plans. In both countries, food security is a priority and more so in the target sites that are in marginal remote settings.

For the Zambia sites, the Ministry of Agriculture and Cooperatives (MACO) has the mandate to facilitate and support the development of a sustainable and competitive agricultural sector. This mission is guided

by the National Agriculture Policy, various legislations, National Development Plans and on an annual basis the Activity Based Budgets.

The ideal is for MACO to provide agricultural services to the farming community which assures food security and income generation without destroying the environment. In line with this mandate, MACO worked closely with AWF and Golden Valley Agricultural Research Trust (GART) – a quasi-government institution, to identify the series of activities that needed to be done in order to successfully pilot conservation agriculture. The MACO team at district level identified the team of 19 extension officers that were trained on various CA techniques to be trainers of the farmers in the sites. The Ministry then identified lead champion farmers that formed the core of the target farmers that subsequently received training and starter packs of inputs for CA. Selection was based on MACO's history of knowing the farmers and their commitment to agriculture and flexibility to accept new techniques, as well as their willingness to dedicate portions of their farmland to CA trials.

The Ministry provided all the extension services required for regular follow up with the farmers including supervising land preparation and other on-farm activities. The MACO team also provided oversight on distribution of inputs and in some cases provided storage of the inputs centrally. MACO joined GART and AWF teams on periodic monitoring and evaluation visits to the farmers each season and participated in the annual seasonal field days. MACO provided all the required field extension backstopping with the major challenge being resource constraints for transport to get to the field. As such, extension teams depended on availability of transport logistics facilitated by AWF and GART. In some cases, the ministry provided vehicles and motorbikes and only needed fuel from the partners.

In DRC, the Strategic Document for Growth and Poverty Reduction (DSCRP) identifies agriculture as one of the most important priority sectors for the national economic growth and thus for poverty reduction. This is also underlined in the reform of the agriculture sector with a new agriculture code adopted by Parliament in May 2011 and signed by the President of DRC. It is on this basis that the government teams supported this project in Ituri as part of their mandate to fulfill this government goal.

Locally, the agriculture extension services of the Mambasa Territory were closely involved with WCS and Pact in the implementation of the project activities with farmers either in the three CBNRM areas or in the OWR and in return, they were provided with means of transport (motorbikes, bicycles, fuel, etc.) to ensure the supervision of agriculture activities across the landscape and received complementary training in agriculture techniques.

Both Zambia Wildlife Authority (ZAWA) and ICCN, government agencies responsible for wildlife management in Zambia and DRC respectively, participated in the mapping of wildlife corridors during PLUP and in human wildlife conflict mitigation activities, both of which are essential exercises in order to better understand dynamics between food security and conservation and how to manage for maximum benefits. The identification, mapping and securing of wildlife corridors is part of the landscape-wide PLUP which zones spaces for different uses, including agriculture. Local communities inform the identification of these corridors and the traditional leaders (chiefs and headmen) as well as local district authorities enforce prohibition of settlements and opening up of crop fields in wildlife corridor areas. This reduces crop raiding and the labor costs of 'chasing off elephants' resulting in better food production in seasons when other climatic variables are favorable.

4.3.2 Traditional leaders

Traditional leaders such as chiefs and village head persons are custodians of the local culture and oversee matters of customary land and its uses. In both sites, they play an important role in the access, use and management of natural resources.

For the work both in Zambia and in DRC, all relevant chiefs and headmen were engaged to introduce the project, and their endorsement was sought on selection of farmers to participate in this pilot phase. They provided assistance to encourage farmers to embrace the new techniques through their endorsement. The AWF team worked with the chiefs to emphasize awareness on the need to restrict clearance of land for crop cultivation in order to protect forests and wildlife habitat.

A challenge that manifests itself regularly and was evident during this project is the inadequate clarity on the roles and responsibilities of the traditional authorities in development processes and this resulted in lack of accountability; independent actions are taken that results in alienation of communal land to private investors or immigrants and settlers (for Ituri) at the expense of locals. The head persons lack sufficient authority to enforce any land use rules and regulations.

4.3.3 Partner Non-Governmental Organizations

Non-Governmental Organizations (NGOs) support government development efforts with resources from non-state sources. They formulate projects and seek funding from local and international donors and implement activities at community level. They tend to be best placed to contribute to the improvement of livelihoods of the local people because they are very close to the people and therefore could mobilize and sensitize communities at low cost for project implementation. This was evident in this project with AWF and GART working well with the communities in Siavonga. In Siavonga, additional partners included Harvest Help Zambia and the Siavonga Nutrition Group that partnered to streamline their work on food aid and HIV/AIDS activities to support some of the farmers participating in conservation agriculture while in Luangwa, AWF worked with WCS's COMACO team.[5] These partnerships helped align community projects and avoid conflicts. Challenges were still encountered with some NGOs, for example those heavily involved in food aid, which can create a dependency syndrome and easily worked against farmers' interest to engage in conservation agriculture, opting instead to get 'free food handouts' (Siavonga farmer, pers. comm.).

In DRC, WCS has formed a consortium with GIC and Pact with shared responsibilities among them, set benchmarks and developed an integrated annual work plan. The distribution of tasks is coordinated by ICCN through the Site Management Committee that oversees all activities across the Reserve. In the OWR for example, GIC is responsible for implementing agroforestry activities and providing technical advice to farmers on agroforestry (leguminous plants) and vegetable gardening in villages and schools, while WCS provides technical advice on food crop production and animal husbandry projects and literacy. Within the CBNRMs, Pact works with local associations to promote environmentally friendly practices while WCS works directly with households to promote food crop production and agroforestry (shade cocoa).

4.3.4 Community-based organizations

[5] See Lewis et al. 2011 for a discussion of the WCS-COMACO program.

Community-based organisations (CBOs) are groupings and associations of producers, learners or businesses who come together to pursue a common interest. They present an effective and efficient way to work with local communities. In Zambia, these mainly take the form of 'co-operatives' registered through MACO as single or multi-purpose agricultural cooperatives and the focus includes crop and livestock production and marketing. The Zambia Wildlife Act administered by ZAWA provides for the formation of Community Resources Boards (CRBs) that spearhead community participation in wildlife management. In this project, experience showed that these CBOS tend to be formed on a 'one-size-fits-all' model with MACO promoting and registering agriculture cooperatives even where they are not appropriate. It was clearly noted in this instance the perverse incentive is that some farmers formed organizations for an alternative benefit other than for the intended development objective (e.g. fertilizer co-ops to receive free fertilizer). Another trend was that of unclear policy guidance on small group formation and registration, and tendency by some NGOs to form multiple CBOs in one locality, which results in a proliferation of opportunistic organizations that compete with one another for resources and do not take a strategic view. In Ituri, this problem is not yet encountered as there is a general paucity of NGOs and CBOs.

4.3.5 Faith-based organizations

Faith communities play an important role in the care and stewardship of natural resources around the world. The Dar Vision for the Future of Biodiversity in Africa recommends working with faith groups to "Strengthen the role of social and development institutions in biodiversity conservation and human well-being." Reaching out to faith communities for dialogue and collaboration is one among many innovative and pragmatic strategies, according to the Dar Vision, which notes that:

> "*Faith-based communities comprise the largest social organizations in Africa, representing a repository of opportunities to spread the cause for sustainability in the continent. Conservation leaders should reach out to religious communities to collaborate in implementing these recommendations, with a view to enhancing the capacity for value-based sustainability decisions that link nature and human well-being*."

Given the important role of belief systems in community culture and behavior patterns, conservationists that reach out to faith communities can enhance their understanding of a community's relationship to the natural world, and help identify opportunities for working together towards a more sustainable future for people and ecosystems.

4.4 Other Key Success Factors

4.4.1 Appropriate scale and boundary

Land, like other forms of natural capital, is not an infinite resource and it is essential to rationalize how it is used in a given landscape. Demand for land is exacerbated by the very nature of rural economies that depend on multiple livelihood strategies and uses that all require space and are often in conflict However, when planned well(as described in section 4.1), this diversified use provides a cushion when some strategies fail and alternatives serve as a coping and resilience-building mechanism. Because of this, the scope, scale and location of conservation agriculture needs to be judiciously determined after considering the totality of the ecosystem processes so as to balance and retain the ecosystem function and services.

4.4.2 Multi-sectoral perspective

Adoption of new agricultural practices goes beyond awareness of techniques and technology into other factors that influence the decision-making process of farmers. The projects require a multi-sectoral approach to planning, implementation, monitoring and evaluation for people involved in literacy, organizational development, savings, microcredit and micro-entrepreneurships as well as community development and social security. Coverage of these aspects allow for accountability for resource use.

4.4.3 Intensity and duration of contact with farmers

There is no ideal intensity and duration of contact with farmers that can be prescribed to guarantee impact, as this is situation specific due to varying contexts. However, in Zambia, it was clearly evident that farmers newly introduced to CA were more skeptical and had relatively poorer results than famers with more years of practicing CA. For crop production and productivity impacts, it was found that after acquiring conservation agriculture knowledge and assets in the form of livestock, participating farmers have potential to make a significant contribution to household food security and income from the third season onwards (Ebbie Dengu, 2008; Tony Kaseke and Justin Django, pers. comm.). This is attested by performance at the Bbakasa Best Practice Agricultural Pilot Plot in Siavonga where the adoption of conservation agriculture principles of intercropping by cooperative farmers increased the diversity of crops harvested in the third year. Measures of nutritional gain were not included and would be essential to include as they can count as indicators for food security improvement.

4.4.4 Market linkages

Most of the areas where conservation organizations work are typically marginal, physically isolated and lack appropriate market services, infrastructure and support systems for the poorest and most food insecure communities. Such areas need marketing support and insurance against marketing and weather risks from the government and the private sector. In Zambia, the National Farmers' Union provides market information services through mobile phone networks, providing prevailing local prices of agriculture commodities as a useful aid to farmers and traders in deciding what crops to grow and where and when to sell them. An important principle in market links is for action taken to start from an understanding of the market and working back from this to production. Grassroots organizations like producer groups and associations could play an important market linkage role. This was exemplified by the Simamba Goat Producers and Marketing Cooperative in Siavonga, in the case of tracking goat markets in Lusaka. The market linkages for Ituri were lacking in the design of the project. The project emphasized its interventions on production and not much consideration was directed to commercialization of the farmers' production.

4.4.5 Guiding policy framework, dialogue and coordination

Issues of poverty alleviation and improved food security are aptly captured at an international level by the Millennium Development Goals (MDGs) that outline a set of internationally agreed targets by the members of the United Nations. Two key goals that relate to the streamlining of CA are (i) Goal 1 that seeks to eradicate extreme hunger and poverty by reducing by half the number of people living on less than USD1 per day, and reducing by half the number of people suffering hunger, and (ii) Goal 7 seeking to ensure environmental sustainability, by among other things, integrating the principles of sustainable development into country policies and programs while at the same time reversing the loss of environmental resources.

These high level international goals are further captured in the continental AU/NEPAD Comprehensive African Agricultural Development Program (CAADP), a strategic framework to guide country development efforts and partnerships in the agricultural sector[6]. CAADP's four pillars include i) Pillar 1 - Land and water management; ii) Pillar 2 - Market access; iii) Pillar 3 - Food supply and hunger, and iv) Pillar 4 - Support to agricultural research (http://www.nepad-caadp.net/, 2008). The use of CA is considered to be one of the main strategies for achieving these pillars, especially in the area of sustainable land management as well as increasing resilience by decreasing food insecurity and linking vulnerable people into opportunities for agricultural growth. At a national level, Zambia's National Development Plan has an overall Agriculture Policy, which aims to facilitate and support the development of a sustainable and competitive agricultural sector that assures food security at national and household levels and maximizes the sector's contribution to Gross Domestic Product (GDP). The same kind of policy frameworks exist in Zimbabwe and Mozambique, where the activities to streamline food security in conservation are being implemented, as well as in DRC within the DSCRP and Agriculture Code, although this awaits implementation.

Such overarching national, regional and global goals for enhancing food security require a supportive policy environment that allows for efficient use of resources. In the case study areas, it is noted that cross-sector coordination is either non-existent or at best inadequate. Policies that govern the use of forests, wildlife, fisheries, water and land resources are alienated and often under the jurisdiction of different arms of government. This results in very restricted focus on resource management themes that are functionally connected but there is no investment to integrate their management. More often than not the political will to advance food production neglects to acknowledge that spaces for crop and livestock production are not infinite and that it is not every seemingly 'unused' land that can be cleared and turned into successful crop production. The role of other non-direct production strategies for food security is only starting to receive attention in the last decade. This growing diversification of livelihoods that support food security and improve the quality of life requires reform in the policy arena to accommodate a holistic, landscape-wide, ecosystem level approach.

CA presents an opportunity to rethink the importance of small holder farming in rural communities. Success and tangible impacts require economic development policies that encourage more diversified agricultural production in rural farms as a foundation for healthy economies and more nutritious diets in rural communities. If complemented by other strategies driven by the natural wealth in these rural marginal locations, sustainable agriculture practices and policies can help foster community institutions that meet the totality of community needs including employment, educational, health, cultural and spiritual needs.

5. LESSONS LEARNED FROM THE CASE STUDIES

Based on the findings described in Section 4, above, the ABCG Food Security Working Group members participating in this exercise, along with some of our key partners, have met to define lessons that should shape our own work as we move ahead in our respective programs. We also hope that the

[6] Agriculture is used here to refer to the entire value chain and to include crop staples, vegetables, fruits, fish, legumes and livestock products. Agricultural growth includes agricultural activities and the up and downstream activities that support growth, including non-farm activities and services.

lessons that we identify prove helpful to colleagues in other organizations working on similar issues to plan and implement their activities more effectively, and avoid repeating our mistakes.

5.1 Role of Agricultural Intensification in African Conservation Strategies

Agriculture intensification has the potential to play a significant role in African conservation strategies through the reduction of agricultural expansion and natural habitat degradation and deforestation and loss of biodiversity, especially if accompanied with other complementary policy, market and management interventions. This can reduce the pressure to convert forest and natural ecosystems to farmland as yields and financial returns per unit of family labor increase, and, in turn, reduce the pressure on critical habitats for wildlife and on natural ecosystems that provide services like freshwater, climate and disease regulation and pollination. Reduced pressure to convert these areas to farmland also opens the possibility of exploring how local communities can participate more fully in the management of their surrounding landscape, including the natural ecosystems, and receive benefits from these management activities in the form of tourism revenues, payments for ecosystem services, and access to markets that pay premium prices for goods produced in environmentally responsible ways. In many cases, the potential of these activities to generate income for rural people far exceeds the income producing of farming. However, to tap this potential, people need to be secure that investing in medium and long-term land management strategies will not render them unable to meet immediate needs, and have the capacity to participate in management structures that are technically and administratively more complex than those to which they are accustomed.

Environmentally-friendly technologies offer the possibility of increasing yields and labor productivity while simultaneously reducing soil disturbances, fossil fuel consumption and agricultural runoff into rivers and streams, thereby contributing to cleaner air, reduced greenhouse gas emissions, and better water quality for downstream users. Such practices include, for example, reduced dependency on chemical fertilizers and promotion of on-farm manure, leguminous cover crops, and agroforestry practices further decreases water contamination. Environmentally-friendly agricultural practices also promote more efficient use of rainwater through such practices as basin farming (pot holing), ripping and intercropping which are efficient at water retention therefore reducing water runoff which would cause excessive soil erosion and sedimentation. Further, environmentally-friendly agricultural practices increase rainwater infiltration and reduce losses by evaporation while at the same time enhanced soil organic matter content improves soil structure and water infiltration and storage. Thus, in addition to decreasing the pressure for farming to expand into wildlife habitat and disturb critical ecosystems, CA can also reduce the negative environmental impacts of farming itself.

However, these benefits are not automatic outcomes of increases in yields and returns to labor, but depend on how we go about our work with farmers. For example, it is important to ensure that we promote broad participation of farmers, including women, who make up a significant number of the producers in Africa, to involve the number of farmers and the amount of land necessary for our efforts to have a social and environmentally significant impact. We can have dramatic impacts on the lives of the smallholder farmers we work with, but if we cannot scale our efforts up to where our efforts have measurable impacts on ecologically significant areas, we will not succeed in changing overall trends in forest conversion and changes in land use. Similarly while increasing yields, incomes, and returns per unit of labor are essential elements of improving farmers' food security, they are not sufficient. We also need to look at the robustness of the farming systems we promote in the face of stresses from changing rainfall and temperature patterns and changing market conditions. Otherwise, climactic and economic

shocks could lead farmers to revert to extensive land use practices and exert even more pressure than they currently are on wildlife habitats and natural ecosystems.

5.2 Keys to Designing Conservation Agriculture Efforts that Lead to Effective Conservation and Food Security

While it is impossible to consider all of the variables that might play a critical role in affecting whether supporting intensified agricultural production, several stand out as factors that require particular consideration.

5.2.1 Size, scale

As noted in sections 4.1 and 4.4.1 , while we must achieve real improvements in yields, incomes and returns to labor, we must operate at the level of areas that are significant in terms of maintaining ecosystem functions and the biodiversity therein that we are attempting to conserve. A community that forms an island of success surrounded by a larger landscape in which nothing has changed does not contribute to conservation and resource management success until and unless the successes achieved there are scaled up to change conditions in the larger area.

WCS attempts to address the issues of size and scale through its landscape conservation approach. Landscape boundaries are defined based on the habitat requirements of species that compete most directly with people in terms of their space requirements, and that are most affected by habitat loss associated with human activity. In general these tend to be large-bodied, slow-reproducing species that utilize multiple habitats, and require large areas of land to support biologically sustainable populations. Often protected areas lie at the core of these landscapes, although these rarely contain the area and habitats necessary to meet the requirements of these landscape species. Thus, in these settings, conservation efforts focus on ensuring the effective management of protected areas, and creating conditions for the management of spaces outside of protected areas that will enable them to continue to meet the needs of wildlife. Thus, in the Ituri landscape, for example, landscape species include forest elephants and okapis, and efforts to stabilize farming systems focus on people living along the highway that passes through the Okapi Wildlife Reserve, inside the protected area, and in areas where farming affects elephant migration corridors and possibilities for maintaining connectivity between the Ituri landscape and Virunga National Park, to the east. In this way, efforts with farmers are concentrated in areas that are of strategic importance in achieving effective management of the overall landscape, and complement more traditional conservation activities like environmental education and support for protected area management.

Similarly, AWF, works through its African Heartlands Programme – an innovative, science-based, and landscape-level approach to conservation that includes both conservation and development goals. Heartlands are biologically important areas, which have the scope to maintain healthy populations of wild species and natural processes well into the future, including in the face of anticipated climate change. Each Heartland is made up of varied land units, including state, community and private lands, covering both protected and unprotected land under various uses. Since there is a critical need to undertake conservation work that improves the livelihoods of local people who live with wildlife, each Heartland operates as a sizeable economic unit in which tourism or other natural resource-based activities can contribute significantly to the lives of local people. Currently AWF works in nine Heartlands ranging in size between 8,000-90,000 km^2 and covering parts of fifteen countries in Sub-Saharan Africa. In order to achieve landscape-level conservation impact, AWF is committed to working in each

Heartland over a minimum of 15 years. AWF has developed the Heartland Conservation Process[7] (HCP) as its approach to setting conservation targets, identifying critical opportunities and threats and for planning, implementing, monitoring and learning from interventions within each Heartland. HCP is a participatory, consultative approach, involving government, community and other stakeholders in each landscape. Based on this HCP, AWF has designed a suite of intervention strategies and applies them in different ways and intensities across the various Heartlands. Strategies employed include: protection of critical habitats and corridors by bringing land under conservation management, development of conservation-based enterprises, applied research and species conservation, development of capacity and leadership for conservation and, where necessary, engagement in policy and legislation work with partner governments. Land use planning and zoning is one important tool which allows AWF to develop a 10-year vision for the Heartland based on desired outcomes for various land use zones within a landscape that contribute towards achieving goals for conservation targets.

5.2.2 Location

Land use activities, and their location on the landscape influence dynamics and pressures between smallholder farmers and natural ecosystems. These are closely related to the size and scale issues, discussed above, as well as issues related to the selection of target populations and definition of approaches for working effectively with them. For example, the conservation objective of reducing pressure on wildlife and ecosystems means that conservation organizations tend to concentrate their work with farmers living in and around protected areas, where critical habitats are facing the greatest pressure from crop cultivation and livestock husbandry. While this makes sense in terms of priority setting, it raises important issues about how we manage our relationships with local people.

The problem of wildlife predation on crops will necessarily be a permanent issue, and programs need to include a suite of options for discouraging crop raiding, which will necessarily evolve over time as animals become more adroit at circumventing efforts to keep them from crops. Indeed, as efforts to improve farming systems show results, the value of what is lost to crop raiding is likely to increase. For example, during the first year of AWF's WEALTH project, elephants destroyed all of the crops in about 50 percent of the fields planted by farmers, with losses being higher in Luangwa District, with its large permanent elephant population, than in Siavonga District, where elephants are more concentrated in migratory corridors and have a more seasonal presence. The conservation goal is to manage these areas so that healthy elephant populations remain in the landscape, but this may conflict with local food security goals. Therefore, a priority for AWF is to work with local people and ZAWA to find ways to cooperate that allow them to manage the situation so there are both conservation and food security co-benefits, and the use of chili pepper based methods to deter elephants is a strategy being applied in the area.

Similarly, crop raiding is a permanent problem for people living in the Ituri landscape's Okapi Wildlife Reserve. WCS's effort to set up permanent agricultural areas received support from farmers because having their fields concentrated in a single area allowed people to work together more effectively to defend crops than they could when individual family fields were dispersed in the forest. Nonetheless,

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[7] Henson, A., Williams, D., Dupain, J., Gichohi, H. and Muruthi, P. 2009. *The Heartland Conservation Process: enhancing biodiversity conservation and livelihoods through landscape-scale conservation planning in Africa*. Oryx. Vol. 43 No. 4 pp. 508-519.

ICCN has been ineffective in working with people to address crop raiding problems, failing to respond to crop raiding incidents in a timely manner, and being more vigorous than its own regulations require in collecting snares placed by villagers. This undermines community support for improving management of the protected area, even though the zoning that defines agricultural zones makes crops more secure. Finding ways to improve cooperation between villagers and ICCN to manage crop raiding more effectively is a priority activity for WCS as part of its support for the implementation of the zoning plan in OWR.

Also, the protected areas around which WCS and AWF work with farmers tend to be located in areas that are not especially well suited for farming, either because of biophysical conditions like soil, topography and precipitation, or because of poor linkages with commodity markets. While most smallholding farmers rely on multiple sources of income, off-farm income is especially important for people in areas that are less well endowed for farming, and some off-farm income is likely to come from poaching, charcoal production and other activities that can undermine healthy ecosystems, unless we identify and develop more suitable alternatives. Combining this makes it especially urgent that we invest in building the capacity of local communities in these areas to participate meaningfully in wildlife management or some other diversification of sustainable livelihoods, and share in the benefits.

By the same logic, on-farm work needs to integrate crops and livestock to improve farm incomes and efficient resources management. Livestock provide essential food products and nutrients and sustain employment and income for rural population. Through animal draught power and manure, livestock contribute directly to increased agricultural production in general and food security in particular. The social relevance of particularly cattle and goats is high for prestige, dowry, as savings for school fees and other expenses, and as a safety net when crops fail. Crop residues feed the livestock which in turn which enrich the soil.

5.2.3 Knowledge management and program implementation

The complexities highlighted above make it important that we conduct participatory land use planning (PLUP) exercises as part of our standard operating procedure for managing knowledge and building shared understanding of critical issues. This approach has been used to good effect in the Ituri landscape (Brown 2009)[8], and in Luangwa and Siavonga districts, in Zambia. PLUP allows local people to engage in an explicit and transparent process of assessing their livelihood options and developing a shared vision for using land and natural resources. It is crucial that it also be carried out with the active participation of local officials with responsibility for allocating rights to use land and natural resources, and overseeing the exercise of those rights. PLUP can thus become the glue that binds the partnerships that are critical for efforts to stabilize and improve smallholder agriculture. It fills this function by providing a process to establish precedents for dialog and discussion between local people and their officials, and securing official buy-in, so that the people are able to hold one another to the agreements reached about land use through official sanction as well as peer pressure. It is crucial the results of these processes are recognized by local government authorities and incorporated into official development planning. Developing and implementing participatory land use plans allows people to elaborate shared understandings of the range of possible productive options, and how these can complement or

[8] Brown, E. (2009). Participatory Land Use in Zoning the Okapi Wildlife Reserve (OWR). Democratic Republic of Congo (DRC). Translinks Case Study. Bronx, NY: Wildlife Conservation Society and US Agency for International Development.

undermine one another depending on their respective spatial and resource requirements. It also provides a starting point for thinking strategically about how families or vulnerable groups might join together in producer associations to obtain more favorable terms for selling products and purchasing inputs, the kinds of bulking and processing facilities that would add value to local production, and where it should be placed, in order for farm families to engage with markets under the most favorable terms possible.

Finally, PLUP provides an opportunity to begin to understand the demographic, social and cultural factors that influence the effectiveness of key land use and resource management messages that we want to impart, and the ability of local people to respond in a positive way. For example, adoption of CA practices tends to be limited to families whose leaders are in the 20-45 year age range. Older farmers are skeptical of new technologies and techniques, and, if their children are grown and moved out, they may not have access to the labor they would to adopt them anyway. PLUP provides a way to begin to identify such issues and define areas about which additional knowledge is needed for actions to be effective.

5.2.4 Defining appropriate time horizons

Successful efforts to improve farming systems for joint food security and conservation benefits across the landscape need to understand when to focus on long-term objectives, and when understanding short-term issues is key. On the one hand, the time required to construct and implement a vision that optimizes trade-offs for people and wildlife is longer than the normal funding horizons of most donors. CA interventions should not be small projects limited to a few years but must be programs of 5-10 years to significantly contribute to conservation and food security objectives that create transformational change in the landscape. This time frame extends beyond the funding horizon of most donors, so it is important for organizations that are planning to undertake these kinds of activities to have a sound strategy for securing adequate levels of funding for the necessary period of time.

However, experience also demonstrates that many farmers cannot wait for a whole, or several, cropping seasons before reaping the benefits of conservation agriculture. Thus, the introduction and production of short lifecycle livestock such as goats, chickens or guinea fowls is key in these rural communities. AWF initiated the Goat Enterprise in Simamba Chiefdom which included the introduction of more productive improved Boer goat breeds purchased from GART as the local breed in Siavionga is the less productive East African Dwarf Goat. In Ituri, through the small grant program, local associations and selected households have been granted money to start livestock production (goats, ducks, fish, and chickens).

5.3 Risks

Efforts to achieve conservation and food security goals through stabilizing and improving farming systems contain a significant element of risk, even if impeccably planned and implemented. One risk is that we undermine efforts to achieve conservation objectives through our success in building stronger farming systems. If we do not heed what we have learned about the importance of spatially explicit program planning and understand trade-offs and synergies across the landscape, the need to provide diversified, sustainable off-farm alternatives, in addition to improvements to farming practice, greater success in farming may encourage people to want to expand the area under cultivation. It is therefore essential to build consensus beyond the farm level about appropriate land use options through continuing participation in planning and implementing land use plans at the landscape level.

As stressed throughout this discussion, efforts to achieve conservation goals through better farming are necessarily based on building the capacity of local actors to manage significant areas of land, literally, from the ground up. Because building capacity, securing collaboration among diverse actors, and demonstrating results that build support and secure necessary funding is necessarily a long process, even the best programs are constantly in danger of being overtaken by events that originate elsewhere. For example, a central government can wipe out years of work with the stroke of a pen by granting a mining concession, or signing a contract for the construction of a road, without consulting and coordinating with local people and their authorities. Similarly, a dramatic rise in the price of a commodity can encourage people to sacrifice the long-term robustness and stability of their production systems in the hope of earning a windfall by producing a cash crop that happens to be in high demand. Changes in temperature and rainfall patterns associated with climate change are taking place even faster than widely accepted models have been predicting, and may render production systems that were well adapted to local conditions considerably less so in a short period of time, leading to crop failures and social conflicts that can undermine the most conscientious of efforts to integrate improvements in farming into a widely accepted sustainable development vision. Therefore, as we take note that undertaking improvements in farming as a means to achieve conservation and food security objectives is a long-term process, we need to understand, and effectively communicate to donors the nature and scale of the threats our efforts face. Despite these risks, our experience leads us to believe that, in areas where people's inability to earn a decent livelihood drives destructive patterns of land use, efforts such as those described here constitute our best hope for protecting the integrity of critical, biodiverse ecosystems, and helping local people secure the means to live with dignity.

6. ASSESSMENT OF TOOLS TO IMPROVE MANAGEMENT OF FOOD SECURITY AND CONSERVATION TRADE-OFFS AND SYNERGIES

As can be evidenced from the case studies above, there are many contributions that the conservation NGO community can make to better support decisions on the increased uptake of conservation agriculture. This section examines two areas of potential contribution in which the conservation community has significant collective experience: spatial planning and community-based approaches. In practice, these approaches represent a continuum of broad-scale approaches to those which are localized and community-led and owned processes, so the following three categories of approaches are considered:

- Broad-scale Spatial Planning Approaches
- Localized Mapping Approaches
- Non-spatial Participatory Natural Resource Management Tools

The role and limitations of these three categories of approach in increasing the uptake by farmers of CA are explored in these sections. Note that presentation of information on these tools is not offered as a comprehensive overview of the full range of options for better decision-making on tradeoffs and synergies between food security and conservation, but only a sub-set. There are many other relevant approaches that also need to be considered in the full arsenal; including those approaches which support the management of regulatory aspects of spatial planning, systematic conservation planning (as a broader methodology for making tradeoffs between production and protection) and economic methods.

6.1 A Review of Broad-Scale Spatial Planning as a Tool for Increasing the Uptake of CA

Spatial planning is not in itself a methodology for CA, but can be usefully embedded into existing methodologies. Ochieng (2001) suggests that spatial planning has been perceived as the exercise of ensuring "an orderly arrangement of spatial land uses" with the "ultimate goal of creating spatial harmony amongst many uses but also to satisfy the environmental, social, economic and physical requirement of spatial residents on the short and *long term* basis". These principles are consistent with the approach of CA, but also suggest a strong focus on awareness raising and conflict resolution between users of land.

Similarly, the issue of accurate representation is one of the key issues on the utility of GIS applications (typically one of the foundations of spatial planning), because the geographic world is "seemingly of infinite complexity, there are always choices to be made in building any representation – what to include, and what to leave out"(Longley et al, 2008).

In this context an approach is considered broad-scale if it relies on centrally resourced information that may or may not accurately reflect the on the ground realities. Table 4 outlines some of the broad-scale spatial planning approaches that are relevant to the uptake of CA in Africa.

Table 4 - Broad-Scale Spatial Planning Approaches for Conservation Agriculture

Approach	Description and Role in CA Context
Spatial Application of a 'Vulnerability Index'	This is common in a climate change context. Such approaches involve a selection of indicators which are then commonly weighted based on perception of priority and presented spatially as a set of sub-national 'hot-spots' of vulnerability. Such approaches are common, including for South Africa under IFPRI (2009); see Figure 4. This could be useful in CA in the food security context, depending on the selection of a good balance of hunger, production and ecosystem measures.
Establishment of Rural Development Scenarios	Using this approach a number (usually 3+) of illustrations of alternative development scenarios are prepared. These typically illustrate tradeoffs between scenarios such as 'business as usual,' 'green development' and 'industrial development'. This approach is generally considered superior to vulnerability indexes as value-based decisions are more likely to be made by decision-makers rather than scientists (World Bank, 2008). Again, utility in the CA context depends on the selection of appropriate parameters within the scenario development (e.g. multi-criteria analysis)
Matching Crops to Ecoagricultural Zones	Such approaches can be useful where there is: a) good data, and b) appropriate methods to increase farmer uptake. For example CIAT's Selection of Forages of the Tropics (SoFT) tool enables local extensionists to identify local matches between grasses and legumes with ecological niches - based on 23,000 tropical forage varieties. CaNaSTA performs a similar function but uses local climate data as well (The World Bank 2008)
Selective Targeting of Pesticides and Fertilizers	In cases where use of pesticide and inorganic fertilizer can still be an option, careful targeting can be aided by spatial approaches. For example, selective placement of precision nutrients can significantly reduce environmental and cost implications of broadcasting approaches. For example, in Malawi the Rockefeller Foundation funded a nationwide soil and cropping survey that resulted in recommendations for over 1,000 distinct regions (Ley, 2005).
Drought Risk Assessments	A better understanding of the risk of drought could be useful in preparedness activities and thereby reduce the 'spike' in environmental degradation that accompanies drought and drought recovery. Initiatives such as FEWSNet, AGRHYMET and the Sahara and Sahel Observatory (OSS) illustrate how drought risk can be modeled, but previous attempts to model drought risk have produced unsatisfactory results due to a lack of sufficient and suitable data (UN/GFDRR, 2011). Remote sensing of soil moisture content can also be used for the purpose of near-term drought forecasting.
Remote Sensing as a Compliance Tool	There are an increasing number of examples of cases where remote sensing can be used to ensure compliance with conservation-related laws. For example in Brazil, remote sensing was used to monitor compliance with the soy moratorium and the use of the associated satellite images "reduced by almost 80% the need for aerial survey to identify soybean planting and allowed monitoring of all deforested areas greater than 25 ha." (Rudorff, 2011)

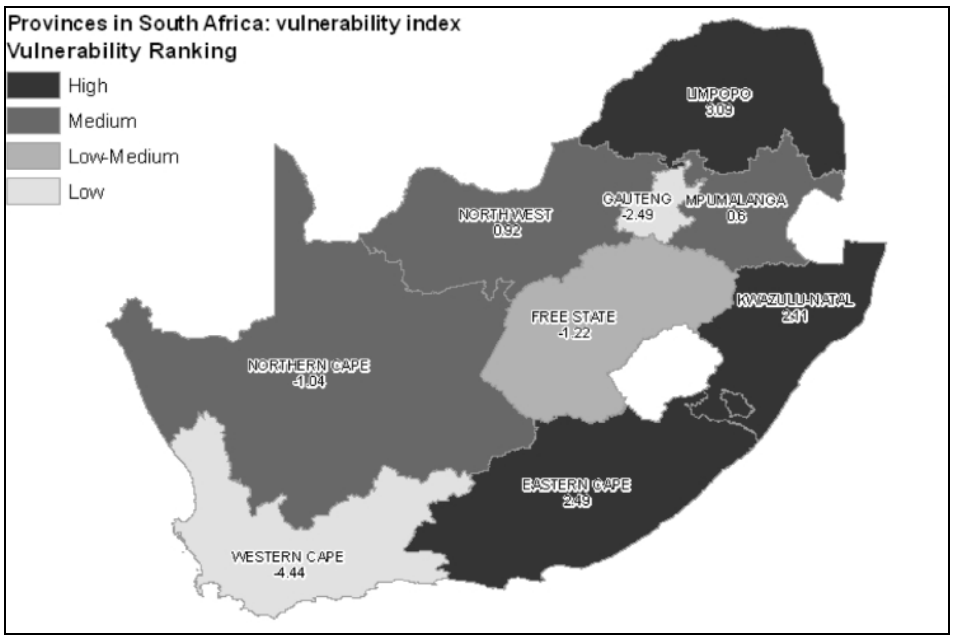

Figure 6 - Vulnerability indices across the farming provinces in South Africa (IFPRI, 2009)

Challenges to the effectiveness of broad-scale spatial planning approaches that are relevant to delivering CA in Africa include the following (Hibbard et al, 2008, Ochieng, 2001, Harris et al, 2002):

- There is a risk that such approaches disempower and marginalize indigenous communities;
- Such approaches can facilitate the imposition and legitimization of external values, interests and plans;
- The digital spatial data that is used for such approaches in Africa is commonly unreliable, expensive to purchase, deemed confidential by the authorities or has not been collected;
- The equipment, software and skills for GIS are expensive to develop and maintain;
- Over-concentration of services and infrastructure in the urban areas;
- Lack of institutional and inter-sectoral coordination frameworks for development planning at national, regional and urban levels.
- Inadequate and/or defective national planning policies and instruments leading to a general failure of planning goals.

Such shortcomings have caused a great deal of frustration over recent years, but more appropriate methods are rapidly becoming common in their availability and application. Andelman (2011) notes that:

> "*One of the key challenges in applying spatial planning approaches is availability of data that meets the high quality standards of researchers. While such standards are important safeguards for academic integrity, it is becoming increasingly common in the conservation community to look for methodologies that allow 'scaling up' of spatial planning approaches and rely more heavily on combined remote sensing and local validation to inform planning decisions*".

6.2 A Review of Localized / Participatory Mapping as a Tool for Increasing the Uptake of CA

Localized, or participatory, mapping has become fairly common in the last 20 years as an approach that addresses some of the challenges with broad-scale spatial planning approaches outlined above, and is frequently the foundation for PLUP (outlined in the case study section). According to Corbett (2009) participatory mapping is the creation of maps by local communities – often with the involvement of supporting organizations, including governments (at various levels), NGOs, universities and other actors engaged in development and land-related planning.

Some of the key participatory mapping approaches are described in the table below.

Table 5 - Participatory Mapping Approaches for CA (Adapted from Corbett 2009 and others as noted)

Approach	Description and Role in CA Context
Mapping of Farmer Practices Based on Qualitative Methods	This survey-based approach can be used for a number of applications such as analysis of locally developed resource practices in the context of complex adaptive systems and the capacity to deal with uncertainty and surprise. An example comes from a study in Tanzania in which households were selected based on access to a common pool resource – a pasture area (Tengo and Belfrage, 2004).
Ground Mapping	Drawing maps on the ground from memory using available materials. This can be useful in acquainting community members with maps and building confidence. In the context of CA, such basic approaches could be used to demonstrate soil erosion and/or loss of related vegetation.
Sketch Mapping	Freehand drawings drawn on large pieces of paper from memory. This is more transferable and permanent than ground mapping and can be more compatible with other forms of information ,e.g. scale maps from agricultural or forestry authorities.
Transect Mapping	This is a spatial cross-section of the community that depicts key geographic features. This can be useful for identifying forest intrusion in areas where agricultural activities are close to the forest boundary.
Scale Mapping	This involves the presentation of accurate geo-referenced data. Also referred to as base maps by practitioners. The transferability is higher than the previous three methods. Some training is required to understand cartographic protocols, and such maps can be more difficult to understand.
Participatory 3D Modeling	These are standalone scale relief models that are created from the template of the topographic map. They are more intuitive than the scale maps and would be, as particularly in CA is there is significant amount of topography that has important environmental connections, e.g. agricultural runoff in areas with coastal or riverine fisheries.
GPS Mapping	A GPS receiver is carried to a position in the field and used to capture an exact location on the earth. Some of the challenges include the gender biased likelihood that GPS receivers are monopolized by men.
Using Aerial and Remote Sensing Images	Using remote sensing maps to discuss physical features in the same way that scale maps are discussed above. This can be relatively expensive and not always available.
Multimedia Mapping	Linking of digital video, photos and written text with maps. They can be used to communicate complex qualitative local knowledge related to the landscape.
Participatory GIS	Computer-based systems that capture, manage, store and present geo-referenced spatial information. It has long been regarded as complicated and costly but can use sophisticated database tools. Local spatial and non-spatial data can be integrated to support decision-making processes.
Internet-based Mapping	Using web-based applications (such as Google-maps) to present local spatial knowledge.

Challenges to the effectiveness of participatory mapping approaches that are relevant to delivering CA in Africa include the following (Kyem, 2006, Corbett, 2009):

- There can be tradeoffs between precision, transferability and local ownership/understanding (i.e. ground mapping vs. scale mapping);
- Local knowledge is not homogenous or uniform;
- Participatory mapping approaches can reveal potential disagreements (especially when boundaries in the past have been contested, overlapping, fuzzy and permeable);
- They are inherently part of a long-term process and short-term objectives should be avoided;
- High levels of trust are required across all participants;
- High levels of transparency are required for all information (and appropriate communication forms);
- Replicability in some of the approaches is limited (e.g. ground mapping)

6.3 A Review of Non-Spatial Community-based Natural Resource Management (NRM) as a Tool for Increasing the Uptake of CA

The tools described below are aimed at developing a shared understanding of problems, agreed visions for the future, and/or assist in the search for solutions. Table 6 below outlines some of the common tools and their application in the conservation context.

Table 6 - Non-Spatial Community-based NRM for CA (Adapted from Lynam et al 2007 and others)

Approach	Description and Role in CA Context
Community-Based Vulnerability Assessments	Such community-based assessments have become common in climate change adaptation planning, deriving adaptation actions from community-level perceptions of problems and ideas for solutions. CARE's Community Vulnerability and Capacity Analysis (2009) is a good example of this. The extent to which CA would be accommodated would depend on the identification of ecosystem issues within the vulnerability process.
Use of Food Calendars	Such an approach illustrates the seasonality of particular roles related to food production and gathering, and can be useful in looking at resilience-building approaches. In CA, this is one of the tools that can usefully examine both the temporal nature of food security, and also the gender roles in gathering, production and preparation activities.
Community Agreements	Such agreements are typically established as internal compliance mechanisms in areas where environmental degradation is accepted as a locally owned problem. Such approaches are particularly important for CA approaches in contexts where clear yield improvements are likely; as yields and incomes increase there may be increased incentive for land clearing if an alternative policy mechanisms is not in place (Schroth et al, 2006).
Networks of Farmer-led Innovation Centers	Such centers are becoming increasingly common in rural development planning, particularly in the climate change context where there is recognition that a) emissions and impact projections are unreliable and b) local knowledge and innovation processes are critical to uptake (Hall et at, 2010). It will be important to ensure that CA approaches are 'on the menu' in such innovation centers. Examples include the Participative Ecological Land Use Model (PELUM) in Kenya (Earthwatch, 2011)
The 4Rs framework	Assesses stakeholders' roles and resilience in forest management. This method analyzes the balance/imbalance of the stakeholders' 4Rs: respective rights, responsibilities, returns, and relationships. When used in group settings, the 4Rs serve as a facilitation tool to help different stakeholders negotiate their respective roles in forest management. The tool does not reveal causal relationships among entities.
The Pebble Distribution Method	A flexible diagnostic scoring procedure that clarifies both the understandings and the priorities of the participants. The facilitator introduces a series of labeled cards and pictures symbolizing the aspects to be scored. Participants then distribute pebbles onto the cards according to the relationships or values of the group. Respondents are then asked to explain the final scores.
Future scenarios	Helps people learn about the future and anticipate the unexpected, particularly in conditions of uncertainty and complexity. Different methods can be used: vision scenarios to elicit people's hopes and aspirations; projection scenarios to identify the consequences of the

	current situation projected into the future; pathway scenarios to illustrate routes of evolving scenarios and design for strategies for change; and alternative scenarios show a range of possible alternatives of the future and clarify uncertainty.
Spidergrams	Provides presentation of the components, attributes, or dimensions of the answer to a clearly articulated question. The tool explores these factors in increasing detail based on the relative contribution of each component. Spidergrams can be generated in either group or individual settings and yield results as weighted figures or tables.
Venn diagrams	This is an easy-to-use visual tool that helps participants explore social relationships between stakeholders. The tool itself does not reveal causal relationships, but it can be used to encourage participants to explore and analyze causal links. Venn diagrams can be combined with a focused discussion among group participants.
Who Counts Matrices	Identifies stakeholders whose well-being is closely linked to forest management and could be adapted for other contexts. The tool suggests seven dimensions for assessing this link and provides a simple scoring technique for determining which stakeholders should be given priority in forest management in a particular locale.

Challenges to the effectiveness of participatory mapping approaches that are relevant to delivering CA in Africa include the following:

- The scalability of community-based approaches is challenging and while 'good news' stories can be identified, the costs and practicalities of scaling up can be difficult.
- The distinction between community-based approaches and community-managed processes is becoming increasingly significant, as some community-based approaches may be co-opted by the objectives or methodologies of external partners.
- The flexibility inherent in participatory tools provides not only increased utility of the tool, but, also means that careless or ambiguous use may yield ambiguous results.
- Many participatory tools have the potential to become ends unto themselves, with practitioners focusing almost exclusively on development of the tool (e.g. computer modeling). This is a trap that needs to be avoided, and the reason why the tool is being used needs to be clearly articulated in terms of a goal or end point that can be reached.

Based on an analysis of all three approach-categories, some conclusions can be drawn. For one, each approach category has its strengths and weaknesses, and its appropriateness in encouraging the increased uptake of CA practices depends on context and realities on the ground. We conclude that applying combinations of tools into single information products should be routine and will reduce risks and establish results of increased credibility and legitimacy. However, such tools need to be matched carefully with objectives of the exercise, resources and the characteristics of stakeholder communities and limitations of each tools need to be carefully considered. The use of these tools should not be zero-sum, or mutually exclusive, and that instead, where applicable, there needs to be a combination of broad-scale, localized and non-spatial approaches utilized. This is critical for Africa due to the severe data constraints and complex resource user-group dynamics. How these tools encourage the desired objectives should also be considered, not just at the farm level but also at the larger landscape level. In this way, these tools can also be connected in the larger PLUP process.

7. NEXT STEPS FOR ABCG FS WORK GROUP MEMBERS

In this section, conclusions and recommendations are provided for both the two project-level case studies, and also general recommendations that cover the lessons from this work, and approaches that aim to convert these lessons to decision-support tools for a broader audience.

7.1 Next Steps for AWF

As part of activities of the WEALTH project funded by the Swiss Agency for Development Cooperation in the last 2.5 years, AWF piloted the application of conservation agriculture in the communal land areas within Zambezi Heartland where local communities already engage in subsistence agriculture. This was part of AWF's conservation action plan in this landscape to rationalize land use for different purposes in order to create space for wildlife dispersal and movements while intensifying agriculture in appropriate zones. PLUP was piloted in four wards of Siavonga in Zambia and the whole of Mbire District in Zimbabwe. The response to CA techniques introduced to the 526 farmers trained was very positive and in order to build critical mass that will have significant biodiversity conservation impact, the following activities are desired for subsequent phases.

7.1.1 Replicate CA techniques among more farmers in Siavonga and Luangwa

AWF would like to increase the number of farmers using CA techniques with support of input starter packs in areas within Zambezi Heartland that were not reached earlier in order to spread demonstration of CA techniques. This will focus in the four wards where PLUP was completed and explicit agriculture zones have been designated with the target on those farmers in this zone that still use conventional agriculture techniques. Activities will include rolling out human wildlife conflict (HWC) mitigation using chili pepper by more farmers and also promotion of production and use of chili. The HWC component will seek to work more with ZAWA to enhance their responsiveness to reports of HWC incidences.

7.1.2 PLUP in Luangwa and micro-zoning in the development zone

In Siavonga District, where PLUP was completed for four wards that are juxta-positioned to wildlife and forest resources, AWF would like to focus follow up work on micro-zoning in the development zones where competition for land creates conflicts. The completed LUP designates a zone for 'mixed development' which also includes agriculture and the idea is to now partition this to micro-zones so as to further reduce incompatible use and also ensure that agriculture intensification through CA can be more effective.

In Luangwa where no land use planning was conducted, AWF plans to formally conduct PLUP following the same model as in Siavonga and then subsequently do micro-zoning in those macro-zones designated for development (which includes agriculture).

7.1.3 Establish and strengthen community-based organizations

AWF has vast experience working with communities across its landscapes, particularly in Kazungula Heartland within Zambia under a similar context setting. A key lesson learned in these areas is that establishing a robust Community Development Trust (CDT) helps democratize decision-making for land uses and reduces land alienation by traditional authorities parceling out land to investors. In this respect, AWF would like to establish two CDTs in Simamba and Sikoongo chiefdoms. These cover the key areas where PLUP was conducted and CA techniques will be rolled out to new farmers. The CDT will spearhead enforcement of the LUP and micro-zones to avoid perverse incentives to expand agriculture in light of successes that result from CA methods.

7.1.4 Further development of AWF's agriculture strategy

AWF is at an advanced stage of developing an organizational agricultural strategy. This will be the white paper that guides how AWF works with partners and applies best practices for sustainable agriculture actions across its pan-African portfolio of landscapes. Lessons learned from the case studies covered under this task will be used to inform AWF's agriculture strategy.

7.2 Next Steps for WCS

As noted above, WCS has worked with local residents and ICCN in the application of PLUP to define agriculture, traditional hunting and conservation areas within the OWR, and the successful definition of these zones has contributed to building a more cooperative relationship for managing the protected area. The priority now is to continue the PLUP process, with the ultimate goal being to build a structure that will permit a collaborative approach, involving local people, government officials and traditional chiefs, to manage the entire landscape. To this end, WCS will undertake activities to continue the implementation of management of the land use zones defined inside the OWR, and undertake PLUP activities with communities located outside the protected area.

7.2.1 Implementing land use zone management in the OWR

By ratifying the rights of villagers to farm and hunt within the OWR, as long as these activities are carried out in the agreed upon areas, the definitions of agricultural, traditional hunting and conservation zones provide a basis for ICCN and communities to collaborate in limiting the number of newcomers who attempt to settle in the OWR and on other matters of shared interest. However, as the plan is implemented, issues have arisen which can undermine cooperation between local communities and ICCN, if not handled well. The three priority issues in this regard are the use of snares, cultivation of perennial crops and rights to exploit trees felled in the agricultural zone.

a. Use of snares

Although ICCN recognizes traditional hunting rights, and its regulations permit snares as a hunting method, it has not yet regulated snare hunting in the OWR. As a result, current practice is that all snaring is prohibited. ICCN officers are instructed to collect all snares that they find in the course of their patrols, and they are paid a bonus for each snare collected. This is a major source of irritation for community members, and they respond by placing more snares in the forest in the hope that ICCN officers will miss some of them. This creates a perverse dynamic whereby the ban on snares is leading to more snares being deployed. Furthermore, the problem of snares is being conflated with the problem of crop raiding by wildlife, because the irritation about the snare issue gets mixed with frustration about the ineffectiveness of ICCN in responding to requests for help when wildlife damage crops.

b. Planting of perennial crops

ICCN does not presently permit the planting of perennial crops like coffee and cocoa inside the OWR. While the reasons for this are clear, permitting tree crops would help maintain the stability of these areas by providing additional sources of food and income that complement annual crop production. This could be important in helping ensure that people continue to confine their farming activities to the agricultural zone over the long-term.

c. Rights to trees felled in the agricultural zone

Presently, ICCN does not allow people to utilize the wood from large trees that are felled within the agricultural zone. Local people can apply for a permit to utilize the trees, but these are only granted in exceptional cases, with the result that a significant amount of timber that could contribute to local livelihoods goes to waste. The DRC forestry code recognizes that trees located on a person's farm belong to the landowner, so it would not be out of line for ICCN to permit people with rights to the agricultural areas to take advantage of timber from trees felled as part of their farming activities. Not doing so contributes nothing to forest management,

denies people a potential source of income, and, like the snare issue, creates friction that interferes with cooperation on other matters.

The solution to all three cases (a, b and c) lies in persuading ICCN to move from a position of prohibiting the activities in question to one of regulating them, so that they are permitted under specified conditions. However, this will require that ICCN trust its partnership with local people to a degree that it has not had to in the past, and it will require local people to respond to greater flexibility by ICCN by exercising greater control over their own activities than they have had to do before. Successful resolution of these issues will place local communities in a position to cooperate with ICCN to exercise a degree of authority over their areas inside the OWR that is comparable to the authority exercised by communities in the CBNRMs, and create a basis for cooperation in managing the overall landscape based on a shared vision of conservation and development. A priority activity for WCS inside the OWR will be to work with ICCN and local people to resolve these three issues during the coming months.

7.2.2 Complete PLUP exercises in communities outside the OWR

WCS is undertaking a PLUP process with the Bakwanza and Andikau community-based natural resource management (CBNRM) areas, which are located to the east of the OWR (see Ituri Landscape map, in Section 2, above). Work already conducted with communities in these areas has constructed a general consensus around the establishment of agricultural areas (for food crops and for commercial crops, including perennials like coffee and cocoa), hunting areas, logging areas and community reserve areas. The community reserve areas adjoin one another, and would be managed jointly by the two CBNRMs. The process has now reached a crucial stage where it is necessary to achieve formal endorsement from local chiefs, who have discretionary power to allocate land. The matter is sensitive because formal endorsement of the PLUP exercise would constitute consenting to have their land allocation powers, an important source of revenue for chiefs, curtailed. Nonetheless, securing chiefly buy-in is essential to establish a basis for managing the area according to principles of conservation and sustainable land use, and provide a measure of protection for wildlife and local livelihoods as plans proceed for beginning mining operations in the many concessions that the central government has granted in the landscape.

7.3 Next Steps for CI

CI's contributions to this report focused on assessment of tools in their capacity to identify and create the conditions under which the optimal synergies for food security and conservation can be realized. These are important aspects of CI's Food Security Initiative, which works to contribute to joint food security and conservation outcomes by planning for resilient, sustainable landscapes, encompassing both the conservation of healthy wild food and genetic resources and the promotion of sustainable production systems. A key part of the design and implementation of this Initiative is development of a robust M & E framework with clear metrics that measure impact. A key barrier to the broader uptake of CA is the reluctance of the ARD community to mainstream CA as part of their standard interventions, in part because there is not sufficient data and scaling-up associated with CA to convince practitioners and decision-makers of the livelihoods and environmental returns on investment from CA. Monitoring and reporting of metrics that 'tell the story' of the advantages of CA, in comparison with other alternatives, will be an important part of reducing this reluctance.

As an example of a food security and metrics related initiative that CI is undertaking comes from the Tropical Ecology Assessment and Monitoring (TEAM) Network. This work involved development and field testing of a set of standard metrics for ecosystem services in areas of agricultural intensification, based on a site in the Udzungwa Mountains National Park in Tanzania. To its south, the Kilombero Valley

was targeted by the Tanzanian Ministry of Agriculture and international donors for around $65 million in investments to double food production over a three-year period. The farmers there depend directly on ecosystem services from the Udzungwa Forest — including water, wood for fuel, bush meat and protection from erosion — for their agricultural production and livelihoods. For the pilot, a number of parameters were monitored including biophysical properties (from biodiversity to water quality and climate); agricultural productivity (for example, areas planted and crop yield); livelihood measures (such as household income and under-five mortality rates); and resilience of natural and human systems to climate variability.

CI will continue to grow its tools and knowledge base on metrics for food security and conservation initiatives as an integral part of the performance framework for the Food Security Initiative. As such CI will ensure that this growth is also guided by the needs of the ABCG FS Working Group, and that ABCG benefits from the development of these tools.

7.4 Next Steps for ABCG Members and Others Working on the Intersection of Food Fecurity and Biodiversity Conservation

Based on the field observations gathered as part of this assessment, the analysis of approaches and discussions held with colleagues as part of the process of preparing this report, we have aimed to contribute to a better understanding of practicalities of implementing CA in Africa with joint conservation and food security outcomes. This involves three areas of related work, described in detail below:

- Better defining best practices that ABCG members working on the food security theme apply and advocate in the course of their work on this issue.
- Defining of a set of guidelines to assess the impacts of our efforts to make farming systems more robust, including outreach and communication with other organizations involved in efforts to improve food security.
- Tapping into the poor farmer-led innovation efforts currently underway to ensure that CA approaches are 'on the menu' of options that farmers can consider.

7.4.1 Definition of best practices

This report serves as a discussion document among ABCG members and the community working on biodiversity conservation and food security, illustrating in detail the case studies and a menu of relevant approaches to help guide future work. ABCG members and others can work together to define a set of best practices derived from the experiences to recommend to partners. This would contribute to our own efforts to further conservation and food security objectives by promoting more consistent practice, and clarifying what we understand to be the relationship between more productive smallholder farming and conservation. This is important for defining how work on this issue fits into our larger mission, and providing a basis for building partnerships and alliances with organizations whose missions revolve around improving farming systems. While there is clearly no ‘one-size fits all’ approach to improving the uptake of CA, the case studies and tools review offers an important foundation for the development of such a guide. Immediate next steps would be to test demand for such a resource.

The ABCG FS Working Group has proposed over the next year to lead the development of a knowledge product that is focused on conducting an Africa Review of integrated agricultural landscapes, as a part of Ecoagriculture Partners’ Landscapes for People, Food and Nature (LPFN) Initiative. This provides an opportunity to allow us to build on our work during the past fiscal year and to further refine a set of best

practices, while also leveraging the high-level profile and scientific expertise associated with Ecoagriculture Partners' LPFN Initiative, its partners, and policy and advocacy objectives.

7.4.2 Development of coupled guidelines to assess efforts to promote food security and conservation objectives

Critical to the successful scaling up of CA approaches is provision of salient and defensible performance data which is in the language of agricultural development institutions. This would build on existing work – ABCG's members have been involved in dialogue and a seminar series in collaboration with USAID regarding better integration of climate change and natural resource management into Feed the Future. This effort has focused attention on the importance of ecosystems in creating conditions that increase the ability of people to deal successfully with challenges like climate change and fluctuations, NRM, and feed themselves over time.

Specifically, the best practice guide would include a menu of metrics that targets the information needs of development institutions. Such metrics would be useable in different contexts in different scales, and the conservation community would have the confidence that monitoring and evaluation exercises that utilize such approaches would be satisfactory to mainstream development donors.

7.4.3 Linking with farm-level innovation networks

Based on the experience from the case studies and the literature, the advantages of CA in the context of African agriculture have significant potential for scaling up. The current emphasis within the rural development community to look at networks of farm-level innovation centers is compatible with CA. Such integration with the institutions involved in driving these approaches in Africa will have two distinct advantages. First, it will ensure that the performance frameworks used by the local innovation centers are robust enough to accommodate the advantages of CA, and secondly, it will ensure that the menu of innovations that are considered within these innovation centers include CA practices.

8. Overarching Conclusions

The ABCG FS Working Group collaborated to develop an integrated **set of foundation year activities to facilitate increased understanding on the trade-offs and synergies between food security and conservation across large landscapes, in the African context. These activities are meant to serve as a basis for future efforts by the Working Group, in order to continue to examine the conditions necessary for CA to improve food security, and how to increase on-farm uptake of such practices.**

The AWF and WCS Case Studies illustrated concrete examples of efforts to integrate food security and conservation on the ground. In the Ituri landscape, WCS provided support for improved input packages in the Okapi Wildlife Reserve preceded by a participatory land use planning process that reached agreements on defined zones for farming, hunting, and conservation. In the Zambezi Heartland, AWF worked with partners to pilot application of conservation agriculture techniques and provided improved livestock and crop inputs to increase yields, enable more productive family labor in areas already degraded, and work with farmers to adopt measures to reduce human-wildlife conflict. In both cases, a common element was the need to reduce vulnerability in the face of threats associated with changes in temperature and precipitation, crop raiding and diseases that affect crops, livestock and people.

CI's review connected the implications of the partners' case studies with a complementary analysis of tools and approaches to better understand how to increase uptake of CA by farmers**. One of the primary conclusions of this review was that applying combinations of broad-scale, localized and non-spatial tools should be routine, reduce risks, and establish results with increased credibility and legitimacy. Such tools need to be matched carefully with the objectives of the exercise, resources, limitations of the tool itself, and characteristics of stakeholder communities. This is critical for Africa due to the severe data constraints and complex suite of stakeholders across landscapes.**

Throughout the collaborative work, there were key themes that emerged, in particular, the importance of spatially explicit and participatory approaches. **Other key cross-cutting findings from each organization's review include the need to scale up, the importance of partnerships, and that of a multi-stakeholder perspective.**

In terms of next steps, the ABCG Food Security Working Group will focus its efforts on better defining best practices that improve farm production sustainably across the landscape, informing indicators that link resilient food security and conservation, and tapping into poor farmer-led innovation efforts currently underway to ensure that conservation agriculture approaches are "on the menu" of options for farmers to consider. This will be based on continuing to utilize lessons learned in the AWF and WCS field sites, as well as leading an Africa Review of integrated agricultural landscapes, as a part of Ecoagriculture Partners' Landscapes for People, Food and Nature (LPFN) Initiative.

Overall, our work will continue to be focused on the premise that conservation agriculture can contribute to improving food security and conservation outcomes, especially for the most food insecure that often live along the periphery of natural ecosystems and agricultural landscapes. In addition, we assert that one of the multiple benefits that can be bundled with this approach is increased resilience to changes in weather associated with climate change.

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ANNEX 1 - Factors Contributing to Food Security in Africa (UNEP/UNCTAD, 2008)

1. Availability of food

Lack of consistent access to food

- Enough food may be produced in a region overall, but food insecurity may persist for those who do not have the resources to buy or produce it.
- Farmers may be able to produce or buy enough food for their families after harvest but may be food insecure at other times of the year.

2. Natural capital

Degraded natural resources

- A degraded natural environment, such as poor soil quality, eroded landscapes or inadequate water resources, will compromise food production in an area.

Practice of monocropping

- Monocropped systems are less likely to promote food security than diverse agricultural systems, which are more resilient to stresses.

3. Social capital

Community and group issues

- Where there are poor links within and between communities, with limited networks, partnerships, trust and collective action, credit and responsibility, communities are less likely to cope with and to be able to help each other in times of hardship, food shortages and conflict. Food security and ill-health is likely to be greater in areas with lower social capital.

4. Human capital

Lack of education and knowledge

- Lack of education and agricultural/nutritional knowledge can affect farmers' capacity to adapt to change or to cope with food production stresses.
- Malnourished people are not able to produce food as effectively as those who are well fed.
- The prevalence of diseases such as HIV/AIDS has had serious impacts on food security and nutrition. When family members become ill or die from the virus, households are less able to produce or buy food.
- In sub-Saharan Africa, 11 million children are orphaned by HIV/AIDS. Mortality and morbidity in HIV/ AIDS-affected households has led to decreased farm sizes, loss of income at household level, a higher dependency ratio and a general increase in food insecurity.

Gender issues

- In many regions women are the major agricultural labor force. However, as they are not always recognized for this, they may not control household budgets and often have poor education.
- In areas where men are in control over the household income, less money is spent on food when compared to those where women have control over incomes.

5. Physical capital

Poor infrastructure

- Poor infrastructure (roads, communications and markets for example) affects food security.

Lack of access to appropriate technologies

- Lack of appropriate agricultural knowledge, technologies, methods or inputs can affect food security.

6. Financial capital

Poverty

- Poverty remains the root cause of hunger and malnutrition in the world

Lack of access to markets

- Lack of access to markets means that farmers and communities can neither sell their surplus nor purchase food in times of shortage. This leads to inconsistent food availability thus contributing to food insecurity.

7. Other external factors

Land-tenure issues

- Land-tenure issues can contribute to food insecurity in a number of ways which vary depending on the context. For example, in some areas if a husband dies, the wife cannot continue to farm the land and the land goes to other members of the family. In East Africa, all of the male children of a man inherit his land between them on his death, which means that each person owns increasingly smaller farm plots, making it hard to sustain enough food for the household.

Political issues

- Political problems, including corruption, collusion and nepotism can significantly inhibit attempts to tackle food insecurity.

Climate and natural disasters

- In areas prone to drought or unreliable rainfall, food security can be particularly challenging.
- Plagues of natural pests such as locusts can decimate crops.
- Natural disasters may destroy lives, crops, homes and landscapes.
- In the last 20 years, the average number of deaths from natural disasters has been more than the average for the preceding decade.

Armed conflict and wars

- Political unrest, armed conflicts and wars contribute to food insecurity and prevent food from being produced or accessed.
- Political conflicts are often associated with food security as both a cause and effect.

ANNEX 2 - Linking Food Security and Ecosystem Trends in Africa

As described above, there are many drivers of food insecurity that combine in different ways to result in a very specific set of local vulnerabilities. In order to appreciate the relative importance of ecosystems and biodiversity in this mix of drivers, it is useful to first examine the geographic relationship between food security (and its flux) and ecosystem service state (and its flux) in the African nations.

It should be noted that using such national data is problematic for two reasons. Firstly, it is unreliable, and secondly, it suggests a misleading homogeneity within the countries being compared. Sub-national pockets of food insecurity may be invisible to such studies.

A2.1 - Indicators of State and Flux of National Food Security in Africa

There are a number of national-level measures of food security; the most common are presented in Table 1. Each of these measures has strengths and weaknesses, as described in the 'Assessment' column.

Table 6 - Measures of National Food Security/Hunger used in Global Studies

Title	Application/Source	Assessment
MDG - Proportion of Undernourished in Total Population	Mapped as an indicator of Hunger by FAO: http://www.fao.org/economic/ess/food-security-statistics/fao-hunger-map/en/ and described in the 2008 State of the World Food Insecurity Report: http://www.fao.org/docrep/011/i0291e/i0291e00.htm	Simple measure, which is universally accepted and relatively well collected. We could either look at the 2003-05 figures or the trends over the three available data periods. One limitation is that it only covers dietary energy and not nutrition.
MDG – Percentage of Children Age 0-5 Underweight	Mapped as global distribution of hunger by Columbia University: http://sedac.ciesin.columbia.edu/povmap/downloads/maps/atlas/chp2.pdf	Covers a broader range of causes than 'proportion of undernourished', including nutrition and the presence of other health conditions that may lead to poor growth.
Global Hunger Index (GHI)	IFPRI - Global Hunger Index (GHI) uses 3 evenly-weighted indicators, including 'proportion of undernourished in total population' 'underweight children (malnutrition)' and 'child mortality rate': http://www.ifpri.org/sites/default/files/pubs/cp/ghi08.pdf	GHI covers both dietary energy and nutrition (as opposed to 'proportion of undernourished' which is just based on dietary energy) and as nutrition is a more significant factor than dietary energy in mortality in some regions (such as South Asia), the GHI may be considered a more well-rounded measure. Considering underweight children may be worth capturing, but child mortality is caused by much more than just access to calories and nutrition. There are also some very complex synergies of which food security is one factor. For example, combining lack of access to food with lack of safe water, inadequate health care, and poor sanitation and hygiene put children in a higher risk category for measles, diarrhea, respiratory infections and even HIV. Also, this index would effectively count children 3 times.
Countries at Most Risk of Deteriorating Food Security Due to High Food Prices	Used by FAO based on the extent to which countries are net importers of energy products, and of cereals (weighted by the proportion of cereals in dietary energy intake), relative levels of poverty and the prevalence of undernourishment': http://www.fao.org/docrep/011/i0291e/i0291e00.htm	This index includes a number of indicators and some are less relevant (e.g. net importers of energy products). Also, while 'net imports of cereals' may be useful in that it indicates the adequacy of local production, ultimately countries that have high imports are less resilient to price shocks in foods(all else being equal).
Countries Facing Food Crises	Used by FAO – identifies countries with persistent or recurring hunger and malnutrition. These are the countries that currently require external assistance – http://www.fao.org/docrep/011/i0291e/i0291e00.htm	This is predominantly a donor policy tool for preparedness for emergency assistance.

Of all these measures, the Global Hunger Index (GHI) is the most common with the greatest consistency of collection which allows trends to be analyzed, both globally and regionally. Figure A1 presents the 2010 Global Hunger Index by severity: a convenient measure for the state of national-level food security. The distinction between state and flux is an important part of this relationship as hunger can be chronic, cyclic or related to a recent shock (e.g. related to price, natural disaster or conflict) and these two figures can be compared to establish which category the hunger fits into.

Figure A1 - 2010 Global Hunger Index by Severity

Figure A2 illustrates **country progress in reducing GHI scores** (percentage decrease in 2010 GHI compared with 1990 GHI); the flux in food security. Red shading suggests an increase in hunger over this period, whereas orange through green shading suggest slight to significant improvements.

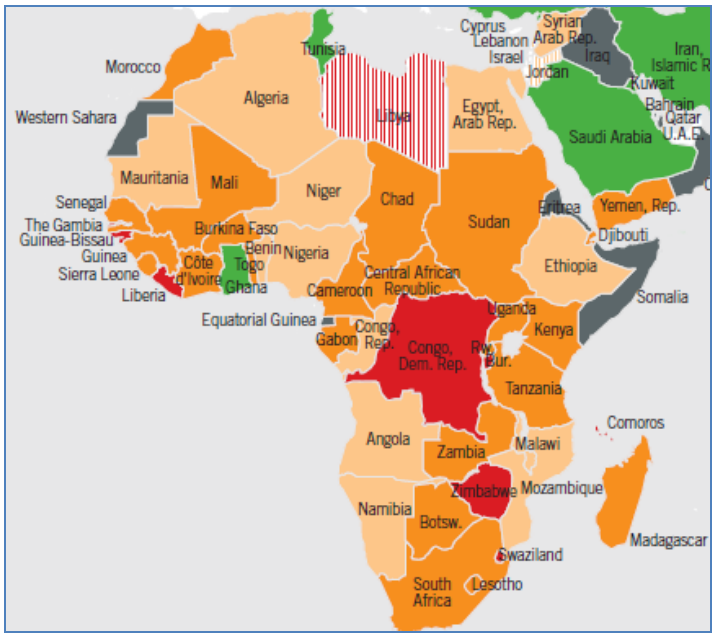

Figure A2 - Trends in Global Hunger Index for Africa (2010 compared to 1990)

The role of drought in African hunger is also significant, as is evident by the current famine in East Africa. In their 2011 Global Assessment Report (GAR), the United Nations suggests that when compared to other hazards, droughts are less well understood. The GAR notes that "a comprehensive assessment of drought risks are only just beginning" and that for "vulnerable rural households even minor drought episodes can lead to yield losses that have devastating impacts on already precarious and non-diversified livelihoods (p 62)."

A2.2 - Indicators of State and Flux of Food-relevant Ecosystem Services

There are a number of measures of national-level ecosystem 'health' that can be relevant to food security activities. One of the most important local ecosystem services that is relevant to conservation agriculture is the role of healthy soil in 'provisioning services. State and trends of soil health will be firstly examined in this section.

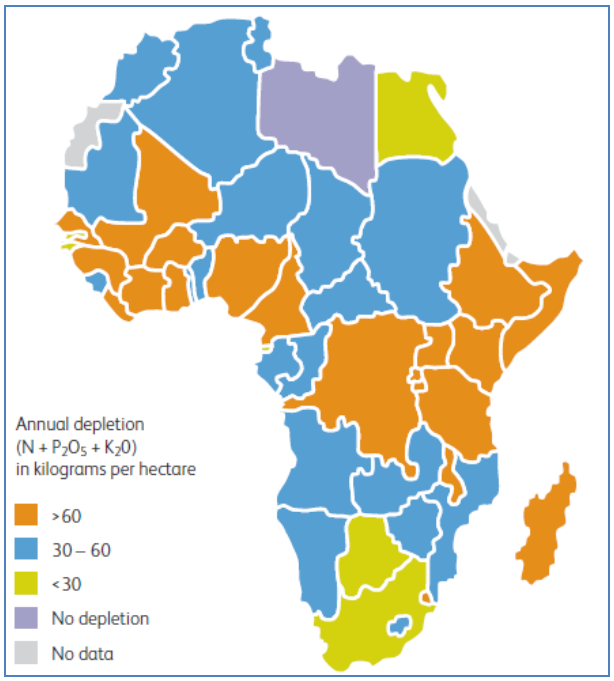

Figure A3 - Average Annual Nutrient Soil Depletion (NPK) in Africa 1993-1995

Much of Africa's soil is derived from ancient granite rocks, which have been subjected to thousands of years of weathering and are therefore inherently low in plant nutrients. For example, the loamy sand and clayey soils of sorghum and millet plantations in central Mali peak at around 20 and 40 kg N/ha respectively in the topsoil, and sampled maize fields in Malawi contain 40 kg N/ha at the most (Conway et al, 2010).

Whatever the original level of nutrients, agricultural activity can reduce soil fertility by depleting nutrients or contributing to soil erosion, and more than 80% of all degraded land globally is located in Africa, Asia, South and Central America (Conway et al, 2010). The net consequence is a continuous depletion of soil fertility. Most African countries lose more than 30 kg of nutrients (nitrogen, phosphorus and potassium) per ha per year (Figure A3).

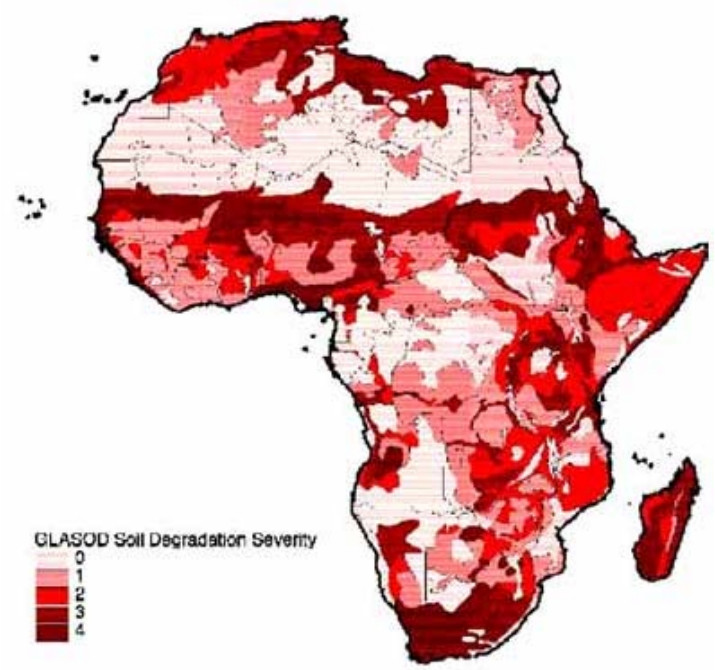

Figure A4 - Human Induced Soil Degradation (GLASOD)

The Global Assessment of Soil Degradation (GLASOD) was commissioned by the UN Environment Program) and remains the only global assessment of land degradation (Figure A4). It has been an important source of information for many programs, including land and soil management programs, and food security at varying scales since its inception in 1991. GLASOD collated the expert judgments of many soil scientists to produce a world map of human-induced soil degradation at scale 1:10 million. Using uniform guidelines, data were compiled on the status of soil degradation considering the type, extent, degree, rate and causes of degradation within physiographic units. Sonnevald and Dent (2007) examined the relationship between GLASOD data and the prevalence of underweight children and concluded that the prevalence of malnutrition is high in areas with declining yields on poor and highly degraded soils.

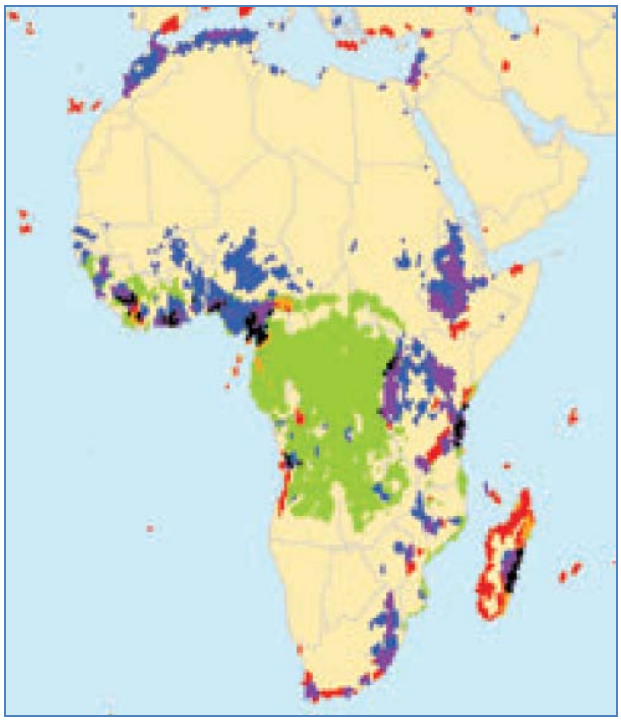

Figure A5 - Comparison of Range-restricted Species, Carbon Storage and Freshwater Provision

Larsen et al (2011) presented area networks (10% of global area) selected independently to maximize representation of range-restricted threatened species (red), carbon storage (green), and freshwater provision to downstream people ("continental optimization"; blue).

The map shows overlaps between priority areas for range-restricted threatened species and carbon storage (orange, 1.7% of global area), range-restricted threatened species and freshwater provision (purple, 5.7% of global area) and all three priority areas (black, 0.8% of global area).

A2.3 - Conclusions on National-Level Relationships between FS and ES

Based on the information presented on national-level hunger and ecosystem data, it is difficult to measure and observe at such a scale the dynamic relationship between ecosystem health and food security. Since many ecosystem service benefits (notably excluding carbon sequestration) are locally manifested (i.e. water quality and quantity, pollination, etc.) there may be substantial sub-national landscapes in which ecosystem services play a core role in maintaining food security, and the underlying stability essential for long-term food security. Hence, it is important to be able to identify these contexts to develop programs and collaborations that capitalize on the conservation of these services.