

**CONSERVATION AGRICULTURE WITH TREES (CAWT) PROJECT:  
SCALING-UP THE SCIENCE AND PRACTICE OF CONSERVATION  
AGRICULTURE IN SUB-SAHARAN AFRICA**



**END OF PROJECT REPORT**

**Draft 1: August 2012**

**JONATHAN MURIUKI, HAMISI DULLA, SAIDI MKOMWA, JEREMIAS MOWO  
AND THE PROJECT IMPLEMENTATION TEAM**

**FUNDED BY: The Swedish International Development Cooperation Agency**

## Table of contents

Table of contents .....	2
List of abbreviations and acronyms	4
Acknowledgements .....	4
Executive Summary .....	5
1. INTRODUCTION .....	8
1.1 Background .....	8
1.2 Case study country selection .....	9
1.3 Formation of the Project Implementation Team .....	10
1.4 Project inception .....	11
2. SITUATION ANALYSIS ON CONSERVATION AGRICULTURE AND AGROFORESTRY IN THE FOUR COUNTRIES .....	12
2.1 Conservation Agriculture in the Region .....	12
2.2 Agroforestry in the Region .....	22
3. EXTENT OF ADOPTION OF CONSERVATION AGRICULTURE AND AGROFORESTRY IN TANZANIA, KENYA, GHANA, AND ZAMBIA .....	30
3.1 Introduction and methods .....	30
3.2 Results and discussions .....	31
3.3 Conclusions .....	45
4. POLICY INCENTIVES FOR SCALING UP CONSERVATION AGRICULTURE WITH TREES IN TANZANIA, KENYA, GHANA AND ZAMBIA .....	48
4.1 Introduction and methods .....	48
4.2 Results and discussion .....	48
4.3 Conclusions .....	65
5. INSTITUTIONAL FRAMEWORKS FOR SCALING UP OF CAWT TECHNOLOGIES: THE CASE OF KENYA, TANZANIA, ZAMBIA AND GHANA .....	67
5.1 Introduction and methods .....	67
5.2 Country Specific Analysis .....	67
Institutional Frameworks opportunities for supporting CAWT in Kenya .....	68
Institutional Frameworks opportunities for supporting CAWT in Tanzania .....	75
Institutional Frameworks Governing CAWT in Zambia .....	80
Institutional Frameworks opportunities for supporting CAWT in Ghana .....	85
5.3 Conclusions .....	91

6.	TOWARDS A REGIONAL FACILITATION MECHANISM FOR SCALING UP AGROFORESTRY BASED CONSERVATION AGRICULTURE .....	92
	6.1 Introduction and methodology .....	92
	6.2 The Africa Conservation Tillage Network.....	93
	6.3 Food and Agriculture Organization of the United Nations (FAO) .....	94
	6.4 World Agroforestry Centre (ICRAF).....	95
	6.5. The African Union - CAADP and Regional Economic Communities (RECS).....	96
	6.6 The role of RECs in scaling up CAWT within the policy frameworks of CAADP ..	102
	6.7 The proposed Regional Platform for fast-tracking CAWT initiatives from national to regional levels for sustained growth and impact .....	105
	REFERENCES.....	0

## **Acknowledgements**

This project would not have been successful without the efforts of several individuals and institutions some of which we list below and others that we might not be able to list but whose contribution is not in any way less important. We acknowledge Sida for funding the project, engaging actively with the project team and even allowing a no-cost extension to ensure that all three outputs could be delivered. We also appreciate the cooperation given by various government and non-governmental institutions some of whom played a very active role in the project. These include, in alphabetical order, the Forestry Research Institute of Ghana (FORIG), Ghana Forestry Commission, Golden Valley Agricultural Research Trust (GART), the Kenya Federation of Agricultural Producers (KENFAP), the Kenya Network for Dissemination of Agricultural Technologies (KENDAT), Ministries of Agriculture in Ghana, Kenya, Tanzania and Zambia, University of Dar es Salam (Institute of Resource Assessment, IRA), University of Zambia (UNZA), and other institutions that formed the CAWT taskforces in each of the four countries. Many CA and agroforestry stakeholders, including smallholder farmers, provided information that was very useful towards output delivery as survey respondents or key informants and we greatly appreciate. Of great value also were enumerators and field assistants that were recruited to help with various aspects of field research.

## **Dedication**

The project implementation team was grieved to learn of the death of Dr. Ebenezer Owusu-Sekyere (pictured below), the project focal person for Ghana who passed away on the last day of the end-of-project workshop (May 11, 2012). Dr Owusu-Sekyere hard battled an ailment for almost the entire project period that made him cede the project implementation in Ghana to Dr. Paul Bosu. We wish to dedicate this report to him. R.I.P



# Executive Summary

## 1. Introduction

Supported by Sida, the World Agroforestry centre (ICRAF) and the African Conservation Tillage Network (ACT) launched the Conservation Agriculture with Trees (CAWT) pilot project in Ghana, Kenya, Tanzania and Zambia. The countries were selected as among those in Africa where there was strong evidence of CA up-scaling taking place. The project was premised on the hypothesis that integrating trees in conservation agriculture systems has the potential to enable smallholder farmers to attain more sustainable production and agro-ecosystems. The project was funded for one and a half years (December 2010 to May 2012). The purpose was to develop a solid knowledge and partnership base for effective up-scaling of a continent-wide campaign for evergreen agriculture among smallholder farmers in SSA including awareness, capacity development and policy guidance. This was to be addressed by generating 3 major outputs as follows:

- (i) The extent of adoption of conservation agriculture by smallholder farmers identified and documented, and the institutional and organizational infrastructure to support up-scaling mapped and analyzed,
- (ii) Policy and institutional factors promoting or hindering large scale adoption of conservation agriculture identified, quantified and documented, and
- (iii) A regional facilitation mechanism for scaling up agroforestry based CA identified.

## 2. Extent of adoption of conservation agriculture and agroforestry

The results of the study reveal that adoption of CA is still very low and slow in the four study countries, with less than 5 per cent of smallholder farmers adopting all three components of CA. More popular is the adoption of one or two components of CA. The factors influencing adoption of CA in the target countries include the age of the household head, household size, access to training resources, knowledge dissemination (through farmer field schools and contact farmer approach) and farmers' perception of CA as potentially mitigating climate change. As such, CA may not be adopted as a one size fits all intervention and there is need to target interventions by taking into account specific local characteristics. Agroforestry (tree crop intercropping) is fairly supported by farmers and this provides hope and impetus for efforts to scale up CAWT. However, this has to be approached with caution since there are specific factors that would encourage adoption by farmers that should be looked into during design and dissemination of interventions. The study also finds that there is need for further research into how CA and CAWT can be packaged and targeted so as to reach large numbers of farmers and those who stand to benefit the most.

### **3. Policy incentives for scaling up conservation agriculture with trees**

This study delves into existing policy frameworks at national level, with specific reference to Ghana, Kenya, Tanzania and Zambia, in a bid to determine whether there exist national policies that support scaling up. As well, the research looks into the roles of regional policy initiatives such as CAADP and Regional Economic Communities (RECs) in scaling up CAWT in Africa. The results of this study reveal that although there is no single policy on CAWT, there are adequate policies related to sustainable land and water management that could potentially advance scaling up efforts at regional and national levels. The study however notes that a blanket policy to fit all countries and their unique social, economic, environmental, physical or political situations may not be practical. As such, the study proposes that CAWT is integrated into existing policy instruments to mitigate challenges facing land use and water management. There is also need for further studies into policy strategies and instruments that could potentially boost scaling up of CAWT.

### **4. Institutional Frameworks for Scaling up of CAWT Technologies**

The study concludes that in general, adequate institutional frameworks exist that are favourable to CAWT. However, the study noted that there is low level of awareness of CAWT practices and poor coordination of such practices/activities in the countries with possible exception of Zambia. There is also very little or no coordination among all the various actors and stakeholders that develop and promote CAWT technologies in the other three countries. In many instances, CAWT activities are carried out in isolation by various actors and institutions. This suggests that CA can best be promoted in collaborations with the existing CBO structures active at the community level. These results suggest that there is a need for formal institutional frameworks to incorporate existing local institutions in the efforts to scale-up adoption of CAWT. Institutional mechanisms are required to ensure that CAWT is seen as a concept beyond agriculture and promote it as a theme ensuring effective linkages between R&D activities. Conservation agriculture with trees needs to aim at broad sense of contributing to livelihood strategies and move towards forming more structures/frameworks with appropriate commercial/agribusiness strategies to create environment for increased rural employment in areas where it is adapted.

### **5. The proposed Regional Platform for fast-tracking CAWT initiatives from national to regional levels**

The nature and size of a National into Regional Task Force for pushing CAWT agenda and activities from farm to policy levels support is absolutely. The first step should be to establish National CAWT Task-Forces (NTF) composed of members from primary institutions



in each country. Each national task force will then have a Chair or another member (as appropriate and efficient) to represent their country at the development agendas and gatherings of the particular the particular Regional Economic Community (RECs; no more than 15 Member REC-SLWM-Committee). Eight different RECS have been founded in the continent, each with its own development agenda. Where a country belongs to more than one REC a NTF may want to have different representatives at these. A NEPAD-CAADP-Committee will be composed of eight members, one from each of the 8 RECs recognised by the African Union (AU). It is noteworthy that, if Sustainable Land and Water Management (SLWM), of which CAWT is part and parcel, is implemented under the more promising Value-Chain approach, all 4 CAADP pillars will be important for sustained CAWT advancement. These 8 members may want to define who represents SLWM at various CAADP gatherings, including gatherings held under the other CAADP Pillars. It is proposed that at the AU level, SLWM and CAWT agenda shall be propelled and represented by a, no more than 4 Member AU-SLWM- Continental Committee, whose members will have been selected from the 8 member NEPAD level Committee.

# 1. INTRODUCTION

## 1.1 Background

Declining soil fertility, climatic extremes, high costs of inputs and lack of support for diversified income sources are all critical problems in much of sub-Saharan Africa (SSA). They are widely recognized as responsible for declining agricultural productivity and increasing rural poverty, painting a dismal picture of the capacity of the continent to feed its burgeoning population. In light of these trends, the Conference of African Union (AU) Ministers of Agriculture, Land and Livestock in 2009 called upon Member States to increase investment support to initiatives aimed at strengthening knowledge, advancing technical capacity development, and up-scaling sustainable land management practices including conservation agriculture and agroforestry.

Supported by Sida, the World Agroforestry centre (ICRAF) and the African Conservation Tillage Network (ACT) launched the Conservation Agriculture with Trees (CAWT) pilot project in Ghana, Kenya, Tanzania and Zambia. The project was premised on the hypothesis that integrating trees in conservation agriculture systems has the potential to enable smallholder farmers to attain resilient evergreen agriculture leading to more sustainable production and agro-ecosystems. The project aimed at combining the best of conservation agriculture (CA) and the best of agroforestry (thus conservation agriculture with trees (CAWT)) and result in a working model under different social, economic, biophysical, institutional and policy conditions.

The project was funded for one year (December 2010 to November 2011) and later granted a six months no-cost extension to May 2012. The purpose was to develop a solid knowledge and partnership base for effective up-scaling of a continent-wide campaign for evergreen agriculture among smallholder farmers in SSA including awareness, capacity development and policy guidance. This was to be addressed by generating 3 major outputs, namely:

- (iv) The extent of adoption of conservation agriculture by smallholder farmers identified and documented, and the institutional and organizational infrastructure to support up-scaling mapped and analyzed,
- (v) Policy and institutional factors promoting or hindering large scale adoption of conservation agriculture identified, quantified and documented and
- (vi) A regional facilitation mechanism for scaling up agroforestry based CA identified.



These outputs were to feed into nationally targeted projects on evergreen agriculture including the establishment of a regional team to backstop national teams in scaling up conservation agriculture and agroforestry.

## **1.2 Case study country selection**

The initiative was to first be implemented in five countries referred to as Tier 1, where there was strong evidence of CA up-scaling taking place. These are Zambia and Malawi in Southern Africa, Kenya and Tanzania in East Africa and Ghana in West Africa. Zambia and Malawi are more advanced in integrating trees in CA where more than 300,000 farmers have already been reached. The project would make use of the countries' experience in implementing successful CAWT in the other three Tier 1 countries. The project would be a launch pad for the national programs and a base for seeking further financial support from other donors and investors. In a later phase of the project, other countries (Tier 2) where evidence of CA activities is currently lacking but have clear potential for achieving the level of Tier 1 countries would be made more CA-ready. These countries include Ethiopia, Uganda and Mozambique.

The countries were categorized as being in Tier 1, Tier 2 or Tier 3 depending on the criteria below as drawn from a rapid appraisal conducted by ACT and the Food and Agriculture Organization of the United Nations between February and April 2009:

- a. Receptiveness by Government & Non-governmental institutions in scaling up CA. Key indicators include (i) evidence that government has supported CA substantively and (ii) implemented successful CA projects in the recent past
- b. Magnitude of CA being practiced in the subject country
- c. Geographical distribution of the countries, which results to neighboring country clusters, that will optimize time and energy spent in traveling to and within countries.
- d. Other limiting factors such as political stability of the country and language barrier.

Table 1.1 shows the analysis for 13 African countries and their categorization based on these criteria. Since Malawi and Zambia were both meant to be countries to draw lessons from, it was later decided to drop Malawi and maintain Zambia as the only learning country for efficiency. The project was therefore implemented in Kenya, Tanzania, Zambia and Ghana.

**Table 1.1: Analysis of current CA evidence in selected African countries**

No.	Country	Evidence: CA Area (Ha)	Ranking /remarks
1	South Africa	370,000	Contributor/Associate
2	<b>Zambia</b>	<b>120,000</b>	<b>Tier 1- fast track</b>
3	<b>Ghana</b>	<b>30,000</b>	<b>Tier 1- fast track</b>
4	<b>Kenya</b>	<b>15,000</b>	<b>Tier 1- fast track</b>
5	<b>Tanzania</b>	<b>10,000</b>	<b>Tier 1- fast track</b>
6	Sudan	10,000	Not selected due to political instability
7	Zimbabwe	10,000	<b>Tier 3</b>
8	Mozambique	10,000	<b>Tier 2</b>
9	Morocco	5,000	Not a priority country
10	<b>Malawi</b>	<b>5,000<sup>1</sup></b>	<b>Tier 1- fast track</b>
11	Cameroon	No data yet received	<b>Tier 3 – network</b>
12	Uganda	No data available	<b>Tier 2</b>
13	Ethiopia	No data available	<b>Tier 2</b>

### 1.3 Formation of the Project Implementation Team

The two implementing institutions, ICRAF and ACT constituted leadership consisting of a coordinator from each of the two institutions (Jonathan Muriuki and Hamisi Dulla respectively). These two were supported by a team of specialists from ICRAF and ACT in Nairobi and they altogether composed a project implementation team of six staff (Dr. Jeremias Mowo, Eng. Saidi Mkomwa, Jonathan Muriuki, Hamisi Dulla, Kenneth Masuki, Delia Catacutan and Peter Gachie). A focal person from each of the participating countries was also selected to support the project implementation team as follows: Eng. Jasper Nkanya (Ministry of Agriculture – Kenya), Dr. Simon Lugandu (ACT – Tanzania), Dr. Elijah Phiri (University of Zambia – Zambia) and Dr. Ebenezar Owusu-Segyere (RIP; Forestry Research Institute of Ghana – Ghana). A project advisory committee composed of Dr. Dennis Garrity (ICRAF), Eng. Saidi (ACT), Dr. Frank Place (ICRAF) Dr. Joseph Mureithi (KARI) with consultation from RECs (EAC, SADC, COMESA and ECOWAS) was also proposed. The committee was meant to occasionally and on demand basis offer policy directives and guidance for the project implementation. Due to the baseline nature of the project in its one year the project advisory committee was not yet formalized and is proposed to be formally introduced when data collection and analysis has been finalized and next steps agreed upon so that they can advise one future phases.

<sup>1</sup> The definition of CA in this appraisal took into account practicing of all 3 or any 2 of the 3 principles. Practicing of agroforestry alone, as evidenced by the 150,000 households in Malawi, was excluded.

## 1.4 Project inception

The objective was to identify country focal institutions and key CA/AF players in order to introduce the project to them and agree on implementation modalities. The project implementation team opted to hold country inception meetings instead of a regional one so that a regional meeting would be held to share baseline study findings and chart the way forward on the formation of a regional platform for scaling up CAWT. The country inception workshops were held as follows:-

- Kenya – ICRAF Nairobi – 22<sup>nd</sup> February 2011
- Tanzania – Paradise Hotel, Dar es Salaam – 25<sup>th</sup> February 2011
- Ghana – FORIG Kumasi – 8<sup>th</sup> March 2011
- Zambia – Golfview Hotel Lusaka – 14<sup>th</sup> March 2011



**Figure 1.1: Participants to the CAWT project inception workshop in Kenya, Feb. 22, 2011**

The final project workshop was held in Arusha, Tanzania on May 9-11, 2012, and brought together representatives from the country implementation teams and representatives of donor institutions. Several reports were produced from the studies conducted under the project. This report presents a summary of the findings in these reports but the reports are also available to provide more information.

## 2. SITUATION ANALYSIS ON CONSERVATION AGRICULTURE AND AGROFORESTRY IN THE FOUR COUNTRIES

### 2.1 Conservation Agriculture in the Region

Conservation agriculture (CA) is a combination of tested technologies and/or principles in agricultural production and is gaining acceptance as an alternative to both conventional agriculture and organic agriculture as a means of ensuring sustainability (FAO, 2009). The CA concept encompasses practices such as mulch-based no-till systems (known variably as zero-tillage or direct seeding) and conservation tillage. In no-till systems soil disturbance is restricted to seed sowing while conservation tillage involves some form of soil disturbance, e.g., strip-tillage, ripping and sub-soiling, ridging, and varied locally-adapted reduced tillage practices (Erenstein *et al.*, 2008). CA is a toolkit of agricultural practices that combines, in a locally adapted sequence, the simultaneous principles of reduced tillage or no-till; soil surface cover and crop rotations and/or associations, where farmers choose what is best for them. CA as a concept for natural resource-saving strives to achieve acceptable profits with high and sustained production levels while concurrently conserving the environment (FAO 2009; Bayala, 2011). It is an approach that advocates the concept of sustainable intensification of production (FAO, 2009).

At the level of small-scale farmers, one of the major challenges to the practice of reduced tillage is the availability of sufficient crop residues for mulch. This is a common problem in many regions (Erenstein 2003; Tursunov 2009), and also in sub-Saharan Africa (Bationo *et al.* 2007; Fowler and Rockstrom 2001). Recommendations suggest that at least 30% of soil surface cover with crop residue would be required at planting in order to have the expected effects in CA (Fowler and Rockstrom 2001). But the effect of the mulch in the conservation practice varies according to the mulch type and quantity (Scopel *et al.*, 1998) as well as to the rate of disappearance of the residue through processes such as comminution by termites.

Conservation agriculture (CA) is not 'business as usual', based on maximizing yields while exploiting the soil and agro-ecosystem resources. Rather, CA is based on optimizing yields and profits, to achieve a balance of agricultural, economic and environmental benefits. It advocates that the combined social and economic benefits gained from combining production and protecting the environment, including reduced input and labor costs, are greater than those from production alone. With CA, farming communities become providers of more healthy living environments for the wider community through reduced use of fossil

fuels, pesticides, and other pollutants, and through conservation of environmental integrity and services.

Conservation agriculture is the integration of ecological management with modern, scientific, agricultural production. Conservation agriculture employs all modern technologies that enhance the quality and ecological integrity of the soil, but the application of these is tempered with traditional knowledge of soil husbandry gained from generations of successful farmers. This holistic embrace of knowledge, as well as the capacity of farmers to apply this knowledge and innovate and adjust to evolving conditions, ensures the sustainability of those who practice CA. A major strength of CA is the step-like implementation by farmers of complementary, synergetic soil husbandry practices that build to a robust, cheaper, more productive and environmentally friendly farming system. These systems are more sustainable than conventional agriculture because of the focus of producing with healthy soils.

Conservation agriculture promotes minimal disturbance of the soil by tillage, balanced application of chemical inputs (only as required for improved soil quality and healthy crop and animal production), and careful management of residues and wastes. This reduces land and water pollution and soil erosion, reduces long-term dependency on external inputs, enhances environmental management, improves water quality and water use efficiency, and reduces emissions of greenhouse gases through lessened use of fossil fuels.

Conservation agriculture, including agroforestry specialty crops, and permanent cropping systems, promotes food sufficiency, poverty reduction, and value added production through improved crop and animal production, and production in relation to market opportunities. Reduced tillage leads to lessened human inputs, in both time and effort – this is generally attractive overall, but it is critical in HIV-affected regions.

Conservation agriculture is best achieved through community driven development processes whereby local communities and farmer associations identify and implement the best options for CA in their location. Local, regional and national farmer associations, working through community workshops, farmer-to-farmer training, etc., but with technical backstopping from conservation professionals, are the main players in the promotion of CA.

### **2.1.1 Conservation Agriculture in Kenya**

Conservation Agriculture has gained wide interest among farmer groups, development NGO and Government institutions in Kenya. The Kenya government's Strategy for Revitalizing Agriculture (SRA), 2004–2014, noted that 51% of the Kenya population is food insecure, able

to obtain only limited supplies of food and the food is of low nutritional value (Kaumbutho and Kienzle, 2007). The strategy recognizes that past plans and development programmes have failed to make a real impact in the fight against poverty. It gives the reason for this as partial or no implementation of such plans. Conservation agriculture activities and interventions, as recommended, touch on all the SRA areas. The CA in Kenya may appear as a relatively new concept but not a new practice; some farmers have long practiced aspects of it, although they have not so named it. The term summarizes a farming concept that embraces the simultaneous application of three basic principles which are in one way or the other practiced by the various farming communities,

In Kenya, conservation tillage practices involve use of mulch, ripping and sub-soiling without inverting soil (Gitonga *et al.*, 2008). Although practiced by large-scale farmers especially in the Mount Kenya region, conservation tillage is slowly being adopted by some small-scale farmers, and evaluating its performance in these conditions is presently a priority. Use of herbicides for weed control is not a common practice in Kenya, and means of mechanical weeding is one of the issues being investigated (Gitonga *et al.*, 2008). The Tropical Soil Biology and Fertility institute of CIAT (TSBF/CIAT) initiated a form of conservation tillage involving the use of hand-hoes and weeding restricted to scratching the top 0-3 cm soil, only in the parts with weeds. This is referred to here as reduced tillage. A number of projects supporting CA were implemented in various places in the country. One of the projects include Conservation Agriculture for Sustainable Agriculture and Rural Development (CA-SARD), funded by the German Trust Fund through the Food and Agriculture Organization of the United Nations (FAO) and the governments of Kenya, it was put into operation in five in Kenya—Bungoma, Laikipia, Mbeere, Nakuru and Siaya.

Many organizations and institutions have been involved in conservation agriculture: the Food and Agriculture Organization of the United Nations (FAO), the World Agroforestry Centre (ICRAF), the Kenya Agricultural Research Institute (KARI), the Technical Cooperation Programme Farming in Tsetse Controlled Areas (FITCA), the International Centre for Insect Physiology and Ecology (ICIPE) and the Consortium for Scaling-Up Options for Farm Productivity. FAO had two projects, the Technical Cooperation Programme and Conservation Agriculture and Sustainable Agriculture and Rural Development, which promoted the three principles of conservation agriculture.

FITCA promoted draught animals in farming and collaborated with the then Kenya Network for Draught Animal Technology (KENDAT; now Kenya Network for Dissemination of Agricultural Technologies) and Triple W Engineering on draught animal technology. The FITCA introduced legume cover crops such as mucuna and canavallia. They collaborated with

Monsanto and Bayer East Africa to promote weed control using herbicides (Mwangi *et al.*, 2007).

The CA-SARD was a two-year project implemented between June 2004 and July 2006. The project was part of a scaling up and refocusing process for conservation agriculture, continuing from the pioneering conservation tillage farmer pilot trials that RELMA sponsored from 1998 to 2002. Previous conservation agriculture work had been sponsored by GTZ through the African Conservation Tillage (ACT) Network, and FAO through a Technical Cooperation Project (TCP/KEN/2904, 2002–2004). The CA-SARD project advanced conservation agriculture interventions and made enormous progress, specifically by adopting farmer field school (FFS) methods, training support staff and farmers, bringing in advanced conservation agriculture equipment, advancing artisan training, and forging links with the private sector (Kaumbutho and Kienzle, 2007).

Large-scale farmers in Laikipia have practiced conservation tillage for over three decades, but their small-scale counterparts have only recently learned about it through various donor-funded projects (Apina *et al.*, 2007). It was found that large-scale wheat and barley farmers adopted some aspects of conservation agriculture as a response to the rising cost of production and liberalization of the wheat market in the country. The fact that conservation agriculture is a package that involves application of the three principles, however, makes it unique and applicable to both small- and large-scale farmers in most parts of the country, especially in arid and semi-arid regions. This means that a farmer could start using one of the practices and progressively adopt the others until they achieve zero land tillage, plant directly under mulch, and rotate and associate crops based on their nutritional value and other valuable characteristics (Apina *et al.*, 2007).

Various categories of farmers in Laikipia district had some understanding of conservation agriculture principles. Medium- and large- scale farmers, who have used conservation agriculture in their wheat and barley farms for almost three decades, regard conservation agriculture as a farming practice lying between zero tillage and minimum tillage but with the additional benefit of incorporating crop rotation and fallow systems. These farmers have invested in agricultural machinery that only minimally disturbs the soil, and they share crop residue between mulch and livestock. But even among the large- and medium-scale farmers there were no uniform procedures in conservation tillage (Apina *et al.*, 2007)

Apina *et al.* (2007) reported that the adoption of CA by small-scale farmers is minimal despite being the target of concerted efforts to promote conservation agriculture by various initiatives. Mwangi *et al.* (2007) reported relatively high adoption of fallow cover crops in western Kenya, mostly because the improved fallows are effective in controlling striga. Thus,



KARI has recommended using *Dolichos lablab*, mucuna and canavallia as cover crops suitable in the region, although lablab is widely used because its seeds are edible. Farmers in various areas of Kenya however have practiced a number of CA options which include:

- i. **Crop rotation** where by small-scale farmers cultivated maize, beans, irish potato, wheat and horticultural crops such as *sukuma wiki* (kale), cabbage and tomato in rotation without any specific schedule or plan. The choice of crop to rotate is based on the size of land a farmer owns or can hire, resources to purchase required farm inputs and economic returns expected from the sale of such a crop. Very few farmers relate crop rotation to control of pest and diseases or soil fertility improvement. Large-scale farmers, on the other hand, have crop rotational plans for wheat, barley, canola and fallow. They also have different ways of rotating crops. The large-scale nature of their field operations limits options for crop diversification. For instance, similar equipment is used in all field operations for the three crops.
- ii. **Intercropping:** Traditionally the farming communities in the study area intercrop maize and beans to diversify cropping options for greater yield and increased household income. Few farmers attach soil fertility improvement to this practice. Since beans mature much earlier than maize, they are uprooted and taken to an open place to dry before shelling. The huge heap of bean crop residue is then set on fire. Introduction of *Dolichos lablab* as an alternative intercrop to beans to provide crop cover has gained popularity among some farmers through the farmer field schools established by CA-SARD and the activities of LNRP, both of which have been working with small-scale farmers. Lablab popularity is attributed to the fact that its seeds are a common delicacy for Kikuyu and Meru communities. Large-scale farmers have limited options for intercropping crops because of management implications, which could be costly.
- iii. **Conservation tillage:** Large-scale farmers have invested heavily in minimum tillage equipment. Even though there is little uniformity among farmers on how much they should restrict their tillage operations, use of the disk plough is a thing of the past for large-scale farmers in the area save for its use to break the resistant weed cycle. Following the low rainfall and its unpredictability, farmers have to rely on in situ harvesting of water, using tine harrows at specific times. Mulch planting is found among large-scale farmers mainly from after-harvest residue of wheat, barley and canola crops. While most large-scale farmers control their livestock numbers, grazing is restricted to some sections of the farm. In some cases sheep are grazed in crop fields for short periods to control weeds and also to improve soil fertility through their droppings. These farmers use herbicides for weed control. Small-scale farmers are still glued to conventional farming and they use the Victory plough and the *jembe*. They weed and plant using jembes or machetes. Farmers working with CA-

SARD farmer field schools have access to conservation agriculture equipment and knowledge and are experimenting with conservation agriculture principles on a section of their plots. They use jab planters, or animal- or tractor drawn direct planters. Animal-drawn sub-soilers are used in fields with hardpans, while animal-drawn Magoye rippers are used for in situ harvesting of water. Some farmers at the early stages of adopting conservation agriculture use animal-drawn and pedestrian pull sprayers for applying glyphosate herbicide for weed control before planting.

On the other hand farmers in Siaya district have been practicing CA options such as

- iv. **Farming with permanent soil cover:** Farmers achieved soil cover in arable fields mainly by using living cover crops and mulch made from crop residue and prunings from trees and shrubs. Farmers started using a combination of mulch and living crops. Some planted cover crops during the cropping season or after removing the main crop to cover the whole field. Some cut grass and plant material such as leaves from outside their fields and brought into their fields. Most annual crops are good sources of mulch. After harvest the cereal stalks can be cut and spread evenly over the soil to provide cover. Farmers who adopted conservation agriculture started leaving crop residue in their fields as mulch and no longer grazed livestock in their fields after harvest.
- v. **Rotating and associating crops:** Intercropping cereals with legumes is not a new concept among the farmers. The practice has existed from time immemorial. Traditionally, farmers planted beans, sorghum or maize and cowpeas in one field. The following season they planted tubers, such as cassava or sweet potato, then back to beans and maize or beans and sorghum. Some farmers planted beans, sorghum, maize and cowpeas together. The only difference between this practice and conservation agriculture was that farmers either intercropped lablab and mucuna with maize or planted them as pure stands to fix nitrogen, conserve moisture and provide soil biomass. Where lablab was established as a pure stand, the following season farmers slashed it and planted maize. In Siaya, the most problematic weed is witch weed, *Striga hermonthica*, which is a parasite on maize, millet and sorghum but can be controlled by rotating them with other crops. Maize smut is a disease that can be controlled by rotating maize with crops such as legumes and vegetables. In fields where maize was rotated or intercropped with either lablab or desmodium, striga was rare and if present, few plants in number. This has convinced many farmers to rotate and associate crops.

Finally, farmers who have been exposed to CA technologies have resorted to rotating crops, intercropping cereals with legumes and leaving land fallow to improve soil health. Unreliable rainfall has prompted most farmers to plant cover crops such as lablab to conserve soil

moisture. The youth have slowly been getting interested because CA is not laborious, although making basins, especially in the first few years, can be labour intensive. The aged have also adopted CA because it requires much less labour than the traditional digging and manual planting. The CA has offered farmers an opportunity to see their farms as a business (Mwangi et al., 2007).

### **2.1.2 Conservation Agriculture in Tanzania**

Several indigenous technologies have been developed and some of them adopted by farmers, in an effort to rehabilitate degraded soils. Most of these technologies have one or more features that reflect some of the principles of CA (accumulation of residues on soil surface, minimum soil disturbance, crop rotation, seeding on mulch). It has been reported that, the tropical kudzu "*Pueraria phaseoloides*" was used as a cover crop in the sisal plantations in earlier days in the 1940s. For instance the Iraqw tribe of Mbulu who were forced to the mountains, apart from using terraces, storm drains and ridges in erosion control, were using mulch, grass cover (Kikuyu grass) and pumpkins as cover crops way back in the 1930s.

Most of the indigenous technologies are intended to improve the soil organic matter content and enhance the moisture retention ability of the soil through increased vegetative cover. The resulting organic matter accumulation plays an important role in maintaining the quality of the soil through greater biological activity. It improves the soil structure, contributes to better aeration and determines to a large extent the capacity of the soil to hold water and to exchange nutrients for optimum plant growth. Some indigenous technologies that were developed include:

- i. **Mulching:** Crop residues are useful in conserving the soil, controlling runoff, improving soil physical conditions and increasing soil fertility. In situ mulching was fairly practiced in the country. The practice has declined as a result of other competitive uses of the crop residues such as feed for livestock, fuel and building materials. Mulching however is still practiced in banana and coffee areas and in horticultural crops, in areas of high rainfall such as Arusha, Kagera, Kilimanjaro and Mbeya regions.
- ii. **The Iraqw system:** This is an intensive crop management system practiced by the Iraqw tribe in northern Tanzania. In this hilly area, the entire crop residues in the field and manure from stall fed cattle is incorporated into cultivated ridges. Terraces are made to control soil erosion, and fodder crops are planted on the edges of the terraces for the cattle, being supplemented by grass from fallow fields. Trash lines and cut off drains are also used to slow down surface runoff and to increase infiltration.

- iii. **The Chagga homegardens:** The Chagga homegardens are characterised by an intensive integration of numerous multipurpose trees and shrubs with food crops and animals simultaneously on the same piece of land. A typical Chagga homegarden consists of a three storey arrangement, with large trees such as *Albizia* and *Grevillea* forming the upper most storey, banana and coffee canopies forming the next lower storey and fodder, herbs, and grasses forming the lowest layers (Fernandes *et al.*, 1981). The system provides a continuous ground cover protecting the soil against erosion, and a high degree of nutrient cycling through the accumulated mulch while the trees provide fodder, fuel wood and fruits.
- iv. **Green manure crops:** Green manure crops refer to plant species that can be incorporated into the soil while green to allow for fast decomposition and release of plant nutrients particularly nitrogen. Green manure crops are usually legumes that fix atmospheric nitrogen and the accumulated litter adds organic matter to the soil.
- v. **Legume -Cereal Crop Rotations:** Legumes form an important component of smallholder farming systems in Tanzania (Koinange, 1988). Inclusion of legumes in farming systems involving rotation of crops benefits the cereal crops through biologically fixed nitrogen contained in the legume residues. Other advantages of crop rotations include more efficient use of moisture and soil nutrients, since different crops exploit different layers of the soil for moisture and nutrients. In addition to soil fertility improvement, legumes grown in rotation with other crops will enhance control of some pests and diseases, which is also an important feature of CA (Calegari, 2002).

### 2.1.3 Conservation Agriculture in Zambia

Conservation farming (CF) offers a set of sustainable agronomic practices for Zambian smallholder farmers using either hand hoe or animal draft tillage. The rapid growth of interest in conservation farming invites inquiry as to its potential impact – on both individual farmers and on the environmental sustainability of Zambian agriculture. Evidence available to date suggests substantial increases in farmer yields under CF basins, often in the range of 25% to 100% (ECAZ, 2001; Keyser, 1996; Langmead, 2001).

Zambia's conservation farming movement has emerged as an off-shoot of international technology transfer by large-scale commercial farmers. After importing minimum tillage systems for their own use, the commercial farmers subsequently became strong exponents and supporters of scaled down versions for Zambia's 440,000 smallholder farmers living in low and medium rainfall regions (Oldrieve, 1989; IMAG, 2001). Conservation farming in Zambia – at least in its predominant hand hoe package -- represents a local variant of

traditional minimum tillage technologies adopted in many parts of Africa (Critchley *et al.*, 1994; Reij, 2001). Currently available evidence, though based few field experiments and mostly on single seasons, suggests that conservation farming packages outperform their conventional farming counterparts; and thus offers one promising and potentially sustainable technology for Zambia's low and moderate rainfall zones.

The integration of trees in the farming system offers multiple livelihood benefits to farmers, including diversifying the sources of green fertilizer to build healthier soils and enhance crop production, and providing fruits, medicines, livestock fodder, timber and fuel wood. There are environmental benefits too, in the form of shelter, erosion control, more effective water cycles and watershed protection, increased biodiversity, greater resilience to climate change, and carbon storage and accumulation. In fact, one tropical tree can sequester at least 22.6 kg of carbon from the atmosphere each year. In Zambia, more than 160,000 farmers have extended their conservation farming practices to include the cultivation of food crops within agro-forests of *Faidherbia* trees over an area of 300,000 hectares. The Conservation Farming Unit (CFU) has observed that unfertilized maize yields in the vicinity of *Faidherbia* trees averaged 4.1 t/ha, compared to 1.3 t/ha nearby but beyond the tree.

#### **2.1.4 Conservation Agriculture in Ghana**

The history shows that earliest research on CA (no- tillage) in Africa was carried out in the late sixties in Ghana (Kannegieter, 1967; 1969; Ofori and Nanday, 1969; Ofori 1973). Conservation has always been an official concern in the management of natural resources in Ghana (EPA 2003). The Savanna Resources Management Project (SRMP) was a national programme that focused on developing sustainable land-management systems. It promoted the use of organic resources as a means of improving land resources. It did not have a strong conservation agriculture focus but contained elements such as keeping the soil covered using plant debris. In addition, it sought to strengthen field extension capacity through the creation of a multidisciplinary resource management centre to work in collaboration with local communities and the district level environmental and planning committees. This was to promote integrated management of soil, water and natural land cover.

During a nationwide outbreak of bush fires in 1983, most cash crops such as cocoa and oil palm plantations were destroyed, and some farmers abandoned their fields. As it takes a number of years to re-establish plantation crops, interest shifted to cultivating food crops, mainly maize. Slash-and-burn has been used for decades as the main method of preparing land. This system was seen as sustainable because of the practice of shifting cultivation. Land pressure was low and farmers could afford to use this system to grow crops on fertile soils. Farmers used the land for only a short period, abandoned it and moved to other fertile land.

The farmer then returned to that piece of land after about 7-10 years of fallow. An increase in population with its attendant land pressure made shifting cultivation an unsustainable system of restoring soil fertility. The manifestations of slash-and-burn system were severe depletion of soil nutrients, increased weed load, on-farm erosion, and a general decline in yields (Boahen *et al.*, 2007).

Land pressure forced a number of farmers to abandon the traditional system of shifting cultivation that was previously used to restore soil fertility. Declining yields, as a result of continuous cropping on the same piece of land with reducing fallow periods made it necessary to search for technologies that would increase yields. Research institutes, mainly the CSIR-institutes (Crops Research Institute, Soils Research Institute and Savannah Agricultural Research Institute), responded to the government's call to search for other options by testing technologies such as minimum tillage, mulching, and use of cover crops both on station and on farm. Most of the research work started on station and later extended to farmers' fields for verification. To promote the findings of on-station trials, the Ghana Grain Development Project, launched in the early 1990s, collaborated with Monsanto, Sasakawa Global 2000 and the Ministry of Food and Agriculture (MOFA) to promote minimum tillage and direct-planting techniques.

The no-till programme focused on promoting direct planting and using plant mulch that was derived mainly by using herbicides. The objective was to improve productivity by improving soil organic matter and reducing weed load. The project also worked with input suppliers and credit agencies to address input problems that were seen as a precondition for successfully implementing the minimum tillage programme. The objective was to use plant mulch to address the low soil fertility and increasing weed problems (Boahen *et al.*, 2007). According to Boahen *et al.* (2007), by 2007, the conservation agriculture project was no longer active in Ghana, except for a few demonstrations sponsored by Monsanto for the purpose of selling Round- Up.

The Land Water Management Project started in 1995 as a component of the nationwide Ghana Environmental Resources Management Project. The project aimed at introducing and promoting improved land management practices within farming communities with emphasis on building MOFA capacity to provide adequate extension services on land management. Technologies promoted during the project included soil and water management techniques such as use of cover crops, minimum tillage and animal traction. (Boahen *et al.*, 2007). CSIR-Crops Research Institute in collaboration with International Institute of Tropical Agriculture (IITA) implemented a Cover Crop Programme (CCP). Leguminous cover crops such as *Mucuna*, *Pueraria* and *Canavalia* were screened on-station and on-farm. The Land

and Water Management Project and the Sedentary Farming System Project made use of the findings of CCP in their extension work to promote CA in the Brong Ahafo Region. The conservation agriculture consisted of improving the management of soil organic matter, rotating crops properly, using cover crops to improve short fallow systems, and using animal manure (Boahen *et al.*, 2007).

## **2.2 Agroforestry in the Region**

Agroforestry has been defined as a dynamic, ecologically-based natural resources management system that, through the integration of trees in agricultural landscapes, diversifies and sustains production for increased social, economic and environmental benefits (Leakey, 1996; ICRAF, 2007). It is a collective name for land-use systems in which woody perennials (trees, shrubs) are grown in association with herbaceous plants (crops, pastures) and/or livestock in a spatial arrangement, a rotation or both, and in which there are both ecological and economic interactions between the tree and non-tree components of the system.

The main components of agroforestry systems are trees, shrubs, crops, pastures and livestock, together with the environmental factors of climate, soils and landforms. Trees and/or shrubs deliberately retained or planted on farm land create a web of resilient land use practices that mitigate and adapt to climate change, halt land degradation and conserve on-farm biodiversity. Agroforestry is therefore a powerful tool for tackling emerging local and global challenges. The system is increasingly considered as a solution for limited resources for production and is rapidly emerging as a contributing factor to global sustainable development goals due to key role it plays in transforming livelihoods and landscapes (ICRAF, 2008). It provides diverse benefits including *inter alia* enhancing biodiversity, climate change adaptation and mitigation, food security, and reducing rural poverty by increasing soil fertility and crop yields.

Agroforestry evolved as a formal scientific discipline in the mid-1970s, but its promotion through research and development activities started in 1980s (Otsyina *et al.*, 2010). The evolution of agroforestry in the last three decades has seen a major shift from emphasis on land productivity at farm level to systems interactions at landscape level (Kitalyi *et al.*, 2011). Agroforestry systems provide both local and global ecosystem services. They play significant roles in realizing the goals of the three UN conventions on desertification, biodiversity and climate change. The three conventions seek to mobilize the science, economics, social and political will in order to bring about sustainability in the use and management of the Earth's natural resources and enhance the life-support systems. Agroforestry is embedded in these



conventions due to its ability to transform landscapes and livelihoods by contributing to poverty reduction, improved productivity and achievement of environmental sustainability (ICRAF, 2007).

### **2.2.1 Agroforestry in Kenya**

Agroforestry in Kenya is an ancient practice. It is a new name for old practices as from time immemorial, many farmers nurtured trees on their farms, pasture lands and around their homes. Agroforestry holds substantial promise for ameliorating critical development and environmental problems in Kenya as a land-use system that combines the production of food, livestock, and forest products, preferably on the same unit of land on a sustained yield basis. Agroforestry offers potential for reducing increasing conflicts between arable farming, livestock keeping, and forestry interests, especially in the high-potential areas that are facing intense population growth (Kilewe *et al.*, 1989). Many people use agroforestry products and services in both rural and urban areas every day of their lives to cook with, eat, drink, take as medicine and sit on products grown on agroforestry systems.

Products from agroforestry trees bring the much needed income to the rural families and assure them food and nutritional security especially in drought periods. Trees under agroforestry do provide farmers with many products and services such as food, fuel wood, fruits and nuts, poles, fodder, medicine, timber, mulch, shade and windbreak. They also play an essential role by providing food security to the farming community, covering the soil from agents of soil erosion, enhancing soil fertility by recycling nutrients, improving microclimate, providing living fences, demarcating boundaries, protecting biodiversity and controlling weeds (Franzel *et al.*, 2001). Many farmers in Kenya especially in the highlands have very small pieces of land ranging from quarter of an acre of land to two acres and for this reason there is no other option to meet the above mentioned advantages other than practice agroforestry.

Kenya's national forest cover is less than 3 per cent compared with the internationally accepted level of 10 per cent. Policies have been put in place, which support agroforestry extension officers with a target of achieving 20% of Kenya land under tree cover by the year 2020. These policies are in favour of agroforestry and tree planting in general some of which prohibit cutting down of trees in forest areas. Adoption of agroforestry has improved over the years. Promoting on-farm forestry and conservation of natural environment is ongoing. Initiatives aimed at introducing commercial tree species in ASALs to control desertification and improve livelihoods have been undertaken (ASDS, 2010). There are also other policies in favour of non-governmental organisations to provide agroforestry extension services to the

local communities. Other policies promote non wood forest products such as nectar and honey from bees that forage on tree flowers, gum and resins, medicine and litter from trees for composting and crop fertilisation.

### **2.2.2 Agroforestry in Tanzania**

In Tanzania, agroforestry is potentially important for improving the livelihoods of the majority of people, particularly rural communities, through enhanced food security, primary health care (medicinal plants) and the leading source of fuel energy. Essentially, the system has increasingly become a focal entry point for rural development, environmental stewardship including climate change adaptation and mitigation, and ecosystem sustainability through transformation of livelihoods and landscapes (ICRAF, 2008; Boeckmann and Iolster, 2010; Pye-Smith, 2010). Over time Agroforestry research has developed a wide range of practical and robust technologies for different agro-ecological zones, which have yielded positive and encouraging results in improving food security, livelihoods and environmental resilience (Mbwambo, 2004, Boeckmann and Iolster, 2010; Pye-Smith, 2010). However, human, infrastructure and institutional capacities for agroforestry development are not well developed (Kitalyi *et al.*, 2011).

Tanzania is home to several traditional agroforestry systems that have been in practice for hundreds of years. Some have been documented such as: the Chagga home-gardens, the related Mara region home-gardens known as *Obohochere* and traditional *Wasukuma* silvipastoral system called "*Ngitili*" which is a traditional enclosed fodder reserve for grazing livestock in the dry season. Many agroforestry activities were initiated by the government in the 1980s supported by donors aimed at addressing problems of land degradation. Some of the programmes included SCAPA, SECAP, HIMA, CONCERN as mentioned earlier. For example in Arusha district, agroforestry activities that were undertaken with support from SCAPA included: establishment of on farm tree nurseries, on farm tree planting, protection of water sources, planting trees on hilltops (afforestation), establishment of homestead woodlots, planting of fruit trees and bee keeping. These activities were undertaken in about 118 villages and 87 farm tree nurseries were established in the villages. About 1,500,000 tree seedlings were distributed and 11,000 farmers were provided with basic training on water and soil conservation and land management. Ongoing activities on soil and environment conservation include establishment of tree nurseries, tree planting, woodlots establishment and contour making in two villages of Ikerin and Ngi`res.

Most of the agroforestry research activities have been undertaken by Tanzania Forestry Research Institute (TAFORI) and Agricultural Research Institutes of Tumbi, Selian, Mlingano,

Uyole, Ukiriguru and Ilonga under Ministry of Agriculture, Food and Cooperatives (MAFC). Some of the activities have been supported by ICRAF and other donors. The activities include agroforestry technology development, agroforestry germplasm screening, and dissemination of research findings and technologies. Technologies developed include mixed intercropping, improved fallows, rotational woodlots, fodder production and indigenous fruit and medicinal trees technologies. Research on mixed intercropping and improved fallows using *Sesbania sesban*, *Tephrosia spp.*, *Gliricidia sepium*, and *Cajanus cajan* showed that maize yields obtained from such fertilizer tree systems consistently generate two or more times the yields from farmers' who are practicing continuous maize production without application of external mineral fertilizer inputs. For example in Tabora improved fallows showed that maize yields increased from 882 kg/ha to 1725kg/ha with *Sesbania sesban* and 1640 kg/ha to 3280 kg/ha for *Tephrosia vogelii*

Suitable fodder trees and legumes that have improved fodder quality and quantity have been identified. The fodder bank technology and improved *Ngitiris*, using fast growing fodder trees and shrubs such as *Leucaena pallida*; *L. diversifolia*, *L. collinsii*, *Acacia angustissima* and *Gliricidia sepium* have shown great potential to meet the needs of livestock in the dry seasons. For example, supplementation of dairy diets with 2 - 4 kg of *Leucaena* leaves resulted in 30% increases in milk production in Shinyanga. Also fast growing and high yielding tree species suitable for rotational woodlots that have shown greater potential in alleviating fuelwood shortage have been identified. Some of these include *Acacia crassicarpa*, *Acacia julifera*, *Acacia leptocarpa*, *Senna siamea*, *Leucaena leucocephala* and *Acacia polyacantha*. At present the technologies for domestication and propagation of indigenous fruit and medicinal trees is going on.

There are many other activities which have been undertaken by various institutions including some NGOs reaching more than 500,000 households (Annex III). Generally most of the agroforestry programmes implemented in the country involved some elements of conservation agriculture. The 2004 National Agroforestry Strategy foresees four million rural households adopting and benefiting from agroforestry practices by 2025. Its goal is that by 2020, agroforestry technologies are adopted and contribute to improving the livelihoods of 60% of the country's resource poor households. This goal complements the national development strategy "MKUKUTA", which aims to increase household income while conserving the environment.

### **2.2.3 Agroforestry in Zambia**

Agroforestry has the potential to arrest land degradation and rural poverty by addressing the many land-use problems that confront smallholder farmers in the SADC region. Traditionally,

African farmers have practiced agroforestry since time immemorial (e.g., the slash-and-burn *chitemene* system practiced by the Bemba people of northern Zambia; Ngugi, 2002). The system involves collecting tree biomass and burning it in heaps, then maize or millet crop is usually planted in the resulting calcium and potassium-rich ash.

The launch of the SADC-ICRAF Agroforestry Project in 1986, in particular, stimulated rapid advancement in agroforestry technology research and generation. This regional project involves Malawi, Tanzania, Zambia and Zimbabwe. Thus, Agroforestry as a discipline in Southern Africa started in 1987, through collaborative efforts between the International Centre for Research in Agroforestry (ICRAF; now World Agroforestry Centre) and national agricultural and forestry institutions in Malawi and Zambia. The eastern Province of Zambia was selected for agroforestry research and development because of its high potential as the breadbasket of the country.

The traditional fallows on which farmers relied to restore soil fertility have been shortened by land pressure and are now inadequate to restore soil fertility (Kwesiga *et al.*, 1999). The consequences are a decline in crop yields and household food security. Farmers needed alternative technologies to reverse these trends. Given the relatively larger farms (e.g., three to five hectares) and the widespread use of short-rotation grass fallows in eastern Zambia, a solution to address the declining soil fertility problem should consider fallowing as the entry point. Improved fallow systems, utilizing fast growing, N<sub>2</sub>-fixing leguminous trees were hypothesized not only to provide readily available nutrients for the subsequent crop, but also to increase soil organic matter and hence improved soil physical conditions. The strategy was to use leguminous fallows to accumulate N in the biomass and recycle it into the soil, to act as a break crop to smother weeds (De Rouw, 1995), and to improve soil physical and chemical properties (Juo and Lal, 1977). Nitrogen availability would be increased through N<sub>2</sub> fixation by trees (Sprent, 1987; Giller and Wilson, 1991).

Since planting of trees to improve soil fertility was unknown in Zambia, the challenge was to identify tree species that were well adapted and had potential to increase soil fertility during the fallow period. Such a tree ideotype should be able to grow fast and be out of reach of free-ranging livestock by the first dry season, be resistant to annual fires, and be tolerant of periodic droughts. The selected tree must also grow and survive under N-limiting conditions prevalent in most small-scale farms in Zambia. *Sesbania sesban*, an indigenous shrub, was identified as a potential species because of its wide distribution in Zambia (Kwesiga, 1990), fast growth, ease of propagation and removal, and because it nodulates easily, fixes N, and produces high biomass (Evans and Rotar, 1987). Other shrubs identified as potential solutions include *Tephrosia vogelii*, *Gliricidia sepium* and *Cajanus cajan* which are planted in

fallows for two years after which they are cut back and then followed by two to three years of maize cultivation thus significantly increasing maize yields compared with planting continuous unfertilized maize (Franzel, Phiri and Kwesiga, 2002).

Some of the agroforestry technologies introduced and practiced in Zambia include

- i. **Improved fallows.** Two- and three-year *Sesbania sesban*-based fallows have proved highly effective in soil fertility restoration in the region, particularly in Zambia where land is not a limiting factor and therefore fallowing to restore soil fertility is a practical proposition. (Kwesiga and Chisumpa, 1992). By 1998, about 4665 farmers in Zambia were experimenting with improved fallows (ICRAF, 1998).
- ii. **Indigenous fruit tree domestication:** The domestication of indigenous fruit trees is a significant agroforestry initiative in the SADC region. The importance of indigenous fruits as a source of nutrition and cash was highlighted by ethnobotanical surveys conducted by ICRAF and national scientists in the region including Zambia in 1986–1988 (Maghembe and Seyani, 1992; Karachi *et al.*, 1991; Kwesiga and Chisumpa, 1992).
- iii. **Mixed intercropping with *Gliricidia*:** Maize/*Gliricidia* inter-cropping is an alternative technology for soil improvement where maize and *Gliricidia sepium* are established concurrently on the same plot. *Gliricidia* and *Leucaena* coppicing fallows at Chipata have maintained maize yields at 3.5 t/ha over six seasons without fertilizer applications (Mafongoya *et al.*, 2001).

#### 2.2.4 Agroforestry in Ghana

Many farmers in rural Ghana are interested in transitioning from introduced mono-cultural methods of agriculture to intercropped, multi-storey methods of agro-forestry. Their interests in agro-forestry are rooted in both environmental and economic perspectives concerning agro-forestry's functionality in their ecological and social environments. Agro-forestry is viewed as a way to incorporate a higher diversity of crops, including crops with different varieties of social and ecological value. Agro-forestry can sustain both subsistence crops for consumption (starchy tubers, fruits, and vegetables) as well as value-added crops for export (cocoa, coffee, moringa, and other medicinal plants). Additionally, agro-forestry-based methods of cultivation are more environmentally sustainable. Inter-cropped plants and tree crops in agro-forestry systems sustain healthier soils and provide shade for certain crops and sources of fuel that are valuable alternatives to deforestation.

Many agroforestry projects were established in the late 1980s aiming at establishing tree nurseries in order to provide readily available seedlings for farmers willing to adopt

agroforestry technologies. This was in line with the objectives of the National Agroforestry Policy, which was aimed at establishing and maintaining 350 achievement demonstration centres, 400 nurseries and 30,000 hectares of agroforestry systems nationwide. As of 1992 the rate of achievement stood at 119 demonstrations, 131 nurseries and 1,642 hectares of agroforestry systems an achievement of 34, 33 and 5 percent respectively (Anim-Kwapong, 2004).

NGOs like Ghana Rural Reconstruction Movement (GhRRM), Adventist Development and Relief Agency (ADRA), CARE-Denmark, and Conservation International have been influential in supporting government's effort in empowering farmers to engage in sustainable agriculture through agroforestry. ADRA supported the government's effort in 1989 by launching the Collaborative Community Forestry Initiative (CCFI) programme that established nurseries and supported households with seedlings. Under this programme 20 nurseries were established within 10 years producing more than 4 million assorted tree seedlings including fruit trees like mangoes, cashew, orange, guava, and sweet and soar sop. Woody trees species under production include teak, Eucalyptus spp., Neem, and Albizia lebbeck (Djarbeng and Ameyaw, 2002).

In 1994 two timber firms from Ghana and Denmark, Ghana Primewood Products Limited (GAP) and Dalhoff Larsen & Hornemam A/S established what later become a Joint Forest Management Project between farmers and the project organisers in South-western Ghana. The objective of the project was to get farmers to actively incorporate trees on farm in an area gradually losing its forest cover (Prah, 1994; Appiah and Pedersen, 1998: cf. Asare, 1999). The project distributed fruit trees and timber species to farmers and encourages them to incorporate them on their farms. In 1998 CARE-Denmark began collaborations with the Joint Forest Management Project with the aim of empowering farmers to undergo agro-diversification (Asare, 2004).

Since 1998 Conservation International, in collaboration with government and farmer associations in Ghana, has contributed to sustainable cocoa farming through the promotion of cocoa agroforestry. This forms part of a conservation cocoa programme that promotes cocoa agroforestry as an integral land use strategy to connect patches of the remaining forest fragments through conservation corridors in the south-western parts of the country. As of now, CI has promoted participatory training and extension methodology and created an enabling political climate to support agroforestry in the country. Through these activities farmers have diversified crops, increased yields in cocoa and reduced encroachment into nearby forests (Asare, 2004). Most of the agroforestry developments in the country have included some concepts of conservation agriculture with trees.

Agroforestry research in Ghana is mainly applied research. Institutions involved in agroforestry research include Cocoa Research Institute of Ghana (CRIG), some institutes within the Council for Scientific and Industrial Research (CSIR), various universities, MOFA, and other organizations such as NGOs and the Ghana Irrigation Development Authority (GIDA). The CSIR institutes (Forestry Research Institute, Crops Research Institute, Soil Research Institute, Savanna Agricultural Research Institute) and GIDA conduct both strategic and adaptive research, whereas MOFA only carries out adaptive research. The universities are also undertaking more strategic applied research than basic and fundamental research (Asare, 2004).

Agroforestry research is primarily grouped under two main themes, biophysical and socio-economic-policy issues. Research into biophysical aspects outweighs that of the socio-economic and policy issues. The biophysical research tends to have narrow and specific (not cross cutting) subject matter and is aimed at the academia rather than poor farmers and their livelihood realities. Most of the research projects take place on-station. The various technologies being developed or adapted fall under the following practices: improved fallow, hedgerow inter-cropping/alley cropping, multipurpose trees (MPT) on croplands, fuel wood production, protein banks, live hedges and home gardens. The specific technologies under MPTs on croplands include dispersed planting, line planting, and boundary planting and in situ live stakes for yams (Asare, 2004).

The Forest Resources Creation Project (FRCP) funded by the European Commission was in response to the increased awareness of the need for drastic change in the way natural resources are used. The FRCP promoted agroforestry and soil fertility technologies that assisted farmers to improve the soil fertility status of their farms.



### **3. EXTENT OF ADOPTION OF CONSERVATION AGRICULTURE AND AGROFORESTRY IN TANZANIA, KENYA, GHANA, AND ZAMBIA**

#### **3.1 Introduction and methods**

The objective of this output was to ascertain the status of adoption of CAWT and on-going programmes that, based on the collected information, would form the basis for developing the conservation agriculture with trees investment programmes for four participating countries. A hierarchical process of collating baseline information was adopted in all countries. First, all institutions (government, NGOs, research etc) that dealt with conservation agriculture and/or agroforestry research and development were identified in each country and a checklist detailing the technologies promoted, activity zones in the country the number of farmers reached and their level of success was sent to them to fill. Secondly a farmers' questionnaire was administered in selected areas within the country sampled on a premise to represent the different agricultural regions in the country. This would capture the farmers that had been reached by the various programmes as well as get a feel of farmer-to-farmer extension of CAWT.

The following tools were applied in undertaking the baseline survey

- a) Questionnaire to households heads and representatives
- b) Key informants and institutional interviews (Extension Workers, Local and international NGO Representatives, Government Representatives, development partners)
- c) Focus Group Discussions (meetings, interviews) – these will be used to fill in any gaps in information that will be identified after data analysis

The data presented in this chapter was obtained from reports of baseline surveys on adoption conducted with farmers (a, above) while findings from other tools inform the chapter on institutional framework chapter. Both primary and secondary sources of data were relied on during this research. Primary data was sourced from semi-structured questionnaires, focus group discussions and key informant interviews with relevant CA stakeholders. Secondary sources of data included journal papers, technical documents, books, reports, articles and electronic media relevant to CA and CAWT. Data analysis was done descriptively using tables, charts, graphs, frequencies, percentages and means. Logistic regression analysis was also performed to assess the factors influencing adoption of CA and agroforestry technologies. The Statistical Software for Social Scientists (SPSS) was used to conduct the analysis.



**Plate 3.1 Intercropping *Gliricidia sepium* with Maize in Zambia**

## **3.2 Results and discussions**

### **3.2.1. Description of sample characteristics**

Majority of the household heads in the four study areas were aged between 35 and 55 years, implying that the productive segment of the rural population was actively engaged in farming activities. The household size for most households was between 5 and 7 members and the main occupation for many of them was farming, with few participating in micro businesses or white collar jobs. Household size influences availability of labour required to take up CA activities such as weeding. Households with more adults participating in farming are more likely to rely on family labour, while those with fewer adults may have to result to hiring labour or not adopting certain aspects of CA if they lack financial means. Over 70% of the households in all countries were headed by males, who were also better educated than their spouses and also better than female household heads. Overall, farmers in the four countries mainly possessed primary level education.

The average land holdings/accessible land varied across countries and were found to be much larger in Tanzania and Zambia (>8 hectares) and lesser in Ghana and Kenya. Kenya's

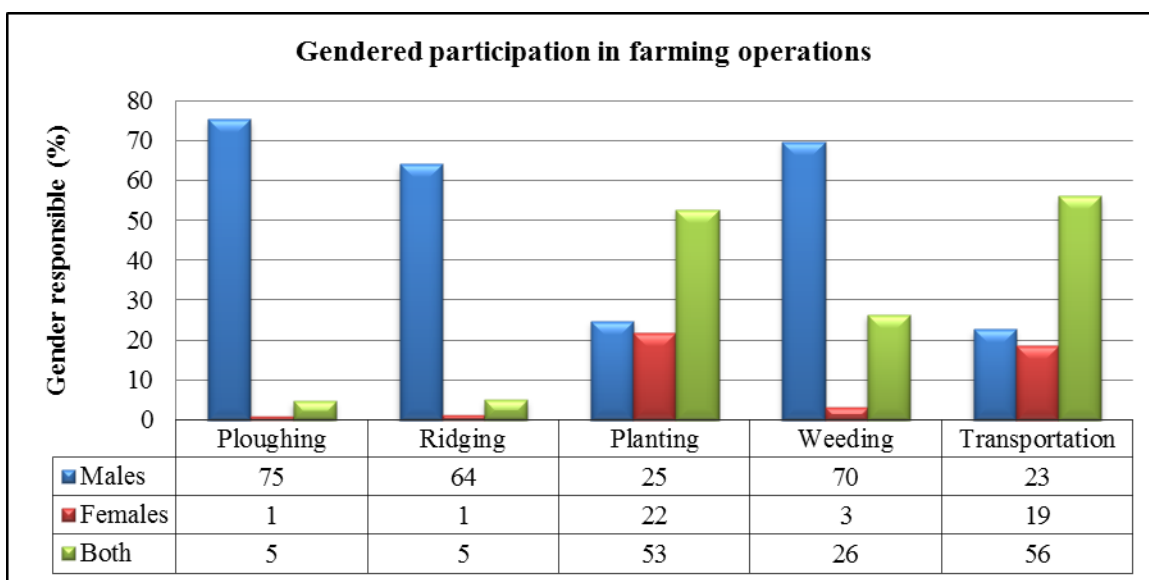
land holdings were the smallest, with average holdings being less than 2 hectares. Land pressure may encourage or discourage adoption of specific CA components depending on the types of enterprises within the farm and the farmers' expectations of benefits. Security of tenure was not considered a constraining factor in the adoption of CA. Family labour was the most commonly used labour source across the four countries. This may imply that the households had enough labour or that they could not afford hired labour. A fair number of households reported that they hired labour during peak periods, especially for weeding, ploughing and planting, which were noted as the main labour constraining operations. Farmers who could not afford to hire labour opted to delay operations until when they had sufficient labour. For instance, 12% of Kenyan farmers reported that they delayed some farming activities during periods of labour shortage. Over 60% of all households practised livestock keeping within their farms, with the highest percentage (90%) being experienced in Kenya. Livestock keeping can encourage adoption of CA due to supply of manure to crop fields or discourage adoption because of competing usage of biomass as mulch or fodder. Competition could also be for space between cover crops and fodder, especially if the cover crops are not edible by animals. The next section of this report looks into adoption of conservation agriculture and the potential for scaling up CAWT.

### **3.2.2. Adoption of conservation agriculture**

CA has been defined as an intervention aimed at managing farming systems to achieve sustained productivity, increased profits and food security while conserving the environment and natural resource base. It comprises the simultaneous application, through good management, of three key principles: minimum mechanical soil disturbance, permanent organic soil cover, and crop rotation or associations. CA is currently being practiced to varying degrees in different countries. While there generally may be visible benefits from CA practice, farmers and other stakeholders who are new or are at the initial stages of converting to CA still require tangible evidence (Mazvimavi, 2011) on the adoption trends of CA, information on whether it is beneficial, challenges faced in its implementation and the opportunities it presents to small holder farmers. More light can be shed on these issues by conducting an analysis of the adoption trends of CA. Some of the information highlighted in this report that can assist in the understanding of adoption trends of CA is related to gender aspects of adoption, technologies preferred by farmers, farmers' knowledge about CA, and factors influencing adoption of CA.

When asked about gendered labour operations (ploughing, weeding, planting, ridging and transportation), farmers in Tanzania reported that at least 50% of all operations were carried out by both men and women. Ploughing seemed to be practiced more by men (41%) as compared to women (9%). The same trend was observed in Zambia and Kenya, where most

farming operations were conducted by both men and women apart from ploughing which was mainly done by men. However, in Ghana, the situation was different with males being the majority contributors to operations such as ploughing, weeding and ridging. Planting and transportation were done by both men and women (see Figure 3.1). Information about which farming operations are carried out by different gender enables the appropriate targeting of interventions and training activities that maybe required in boosting scaling up activities. Specific gender mainstreaming activities are also guided by existing gender practices among rural communities.



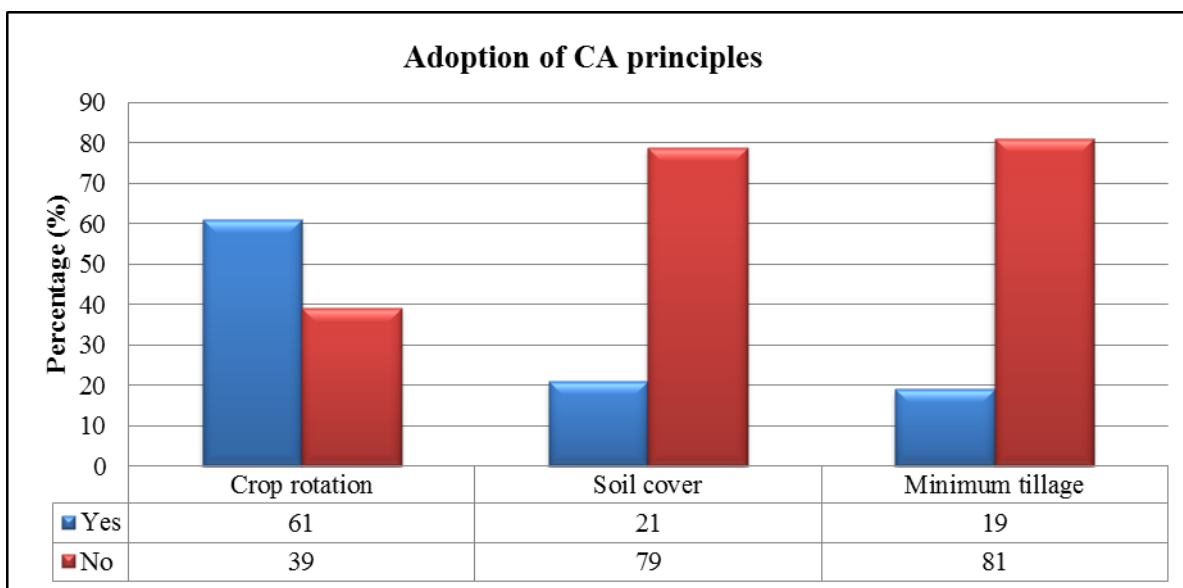
**Figure 3.1: Gendered participation in farming operations in Ghana**

The implements used by farmers to undertake farming operations various differed across countries. In Kenya, the hand hoe (66%) was the most widely used implement while the small scale tractor (17.5%) and ox-plough (14%) came in a distant second and third. The large scale tractor was used by the least number of farmers (2.5%), probably due to implications on cost and maintenance. In Ghana, majority (44%) of the households applied the slash and burn technique to clear their land and most (43%) used the hand hoe for weeding. Tractor drawn disc plough was found to be the most popular (29%) land ploughing technology. Only 1% was found using sub-soiling to plough the land. Half of the households used planting sticks to plant while about two thirds used the hand hoe. Only 8% of the farmers had adopted jab planting. In Zambia, the hand hoe was the most popular implement (24%) followed by the animal drawn yoke (9.6%). In Tanzania, focused group discussions revealed that tillage was mainly by use of the plough and the hand hoe. Based on the implements preferred by farmers, it was apparent that very few farmers used the recommended CA implements. Farmers seemed to have little information about the negative impacts of

continued use of traditional implements. For instance, although farmers ploughed their land to improve the soil tilth and control weeds, in the long term the plough destroyed the soil structure and contributed to declined fertility and organic matter levels. Based on focus group discussions, farmers reported that they lacked sufficient information about recommended CA implements such as jab planters, direct seeders, sub-soilers and rippers. Moreover, their availability was limited hence making it difficult for farmers to embrace CA. There is therefore need for increased efforts towards raising farmers' awareness of the various CA equipment and to conduct further studies into reasons behind the low usage of these implements by farmers.

This study also looked into how knowledge on CA was disseminated to farmers and which strategies were the most effective. The promotional strategies applied included: farmer to farmer sharing of knowledge, demonstration trials, seminars, radio/television, farmer field days or agriculture fairs, house to house visits, printed material and farmer exchange visits. In Kenya, seminars (76%) were the most commonly preferred promotional strategies followed by farmer to farmer sharing of knowledge (70%) and agriculture fairs/farmer field days (69%). The least commonly used strategy was printed material. In Tanzania, seminars were the most preferred mode of CA promotion while demonstration trials and farmer to farmer exchange visits came in second and third respectively. The least preferred modes were house to house visits and printed material. In Zambia, farmers preferred farmer to farmer exchanges most (79%) and the use of printed material was the least preferred (25%). Ghanaian farmers viewed farmer field schools as the most effective (56%) dissemination approach and the use of champion farmers as the least effective (12%) strategy. An important observation is that the most commonly preferred promotional strategies are those that encourage participation and observation as opposed to those that are presented to farmers in form of printed material like brochures. Scaling up efforts will need to consider using strategies that are most preferred by farmers to pass on CA messages to them. This will ensure that the messages are well received and can reach a wide audience.

In addition to information about CA being disseminated through different media, farmers also received support to enable them implement CA from projects or programs that were promoting CA in different regions. The support ranged varied depending on the stakeholders/donors/NGOs involved but was generally in form of free training materials or opportunities and limited input or/and credit subsidies. With regards to adoption of CA as a complete package, this study found that very few farmers were practising all the three recommended components. In most cases, only one or two components were practised. The principle(s) most preferred for adoption varied across different region intra and inter countries. Figure 3 gives Tanzania as an example of the trends in the rates of adoption of CA.



**Figure 3.2: Adoption of CA principles in Tanzania**

Minimum tillage was the least adopted CA component while crop rotation was widely adopted in Tanzania, Ghana and Kenya. This finding could imply that minimum tillage maybe a difficult principle for majority of farmers to perceive and implement, probably because they are accustomed to conventional tillage or because they are not fully aware of the benefits of minimum tillage and the disadvantages of conventional tillage. In Zambia, manual minimum tillage through the use of the basin technique was the most commonly adopted CA principle. The study further notes that adoption levels of the three CA principles in the study countries are very low. Ghana has a 5% adoption rate as well as Tanzania while Kenya’s is 4%.

The research then looked into factors that influenced adoption of CA practices. The selection of factors to include in the models was guided by literature and the authors’ discretion given specific country situations. Table 3.1 shows the hypothesized effects of different variables on adoption and the rationale behind the hypothesis.

**Table 3.1: Hypothesis of determinants of adoption of CA**

Variable	Measure	Expected sign	Rationale
Gender of HHH	1=Male 0 = Female	+/-	Male headed households are likely to adopt CA due to less labour and financial constraints. Alternatively, Female headed households could adopt CA to avoid land preparation constraints such as ploughing
Household size	Number	+	Households with more members have less labour constraints
Age of HHH	Number	+ / -	Younger farmers are likely to adopt because they are risk takers while older farmers may adopt because they have more farming experience
Education of HHH	Categorical	+	Educated farmers are likely to accept new ideas and innovations such as CA
Livestock keeping	1=Yes, 0=No	+/-	Livestock is a sign of wealth and purchasing power. Conversely, competing demands for fodder and cover crops may discourage adoption
Main labour source	1 = Family, 0 = Hired	+	Family labour is more cost effective and easily available
Main occupation of HHH	1= Farming 0 = Otherwise	+	Farmers whose main career is farming are likely to adopt CA to increase their productivity
Farm size	Area in hectares	+	Farmers with larger parcels of land are likely to practise all CA principles
Trees crop intercropping	1 = Yes, 0 = No	+	Farmers intercropping trees with crops are likely to adopt CAWT
Agro-ecological conditions	1=Humid/Sub humid, 0 =Semi arid/Arid	+	Farmers in humid and sub-humid areas are likely to adopt more CA components
Inputs subsidies	1 = Yes, 0 = No	+	Subsidised inputs promote adoption
Access to credit	1 = Yes, 0 = No	+	Access to credit facilitates adoption of CA
Free training	1 = Yes, 0 = No	+	Training enhances adoption through information provision

Knowledge dissemination through farmer field schools (FFS)	1 = Yes, 0 = No	+	FFS promote adoption through information provision
Knowledge dissemination through farmer research groups	1 = Yes, 0 = No	+	Farmer research groups promote adoption through participatory research and observation
Knowledge dissemination through contact farmer approach	1 = Yes, 0 = No	+	Contact farmers enhance adoption through direct contact with targeted farmers
Knowledge dissemination using champion farmers	1 = Yes, 0 = No	+	Champion farmers can use their influence and status to encourage other farmers to adopt
Do trees mitigate climate change?	1 = Yes, 0 = No	+	Farmers are likely to plant and protect trees if they perceive them as mitigating climate change
Perception of CA as beneficial	1 = Yes, 0 = No	+	Farmers who perceive CA as beneficial are likely to adopt it

Source: literature and authors' observations. Legend: HHH: Household head; + (positive effect on adoption of CA); -(negative effect on adoption of CA)

### 3.2.3. Analysis of factors influencing adoption of CA

These findings represent adoption determinants in Tanzania, Ghana and Kenya. Analysis was done using binary logistic regression models. Factors influencing adoption of CA varied between countries as shown in Tables 3.2 and 3.3.



**Table 3.2: Factors influencing adoption of CA in Kenya**

<b>Variables</b>	<b><math>\beta</math></b>	<b>S.E.</b>	<b>Wald</b>	<b>df</b>	<b>Sig.</b>	<b>Exp(B)</b>
<b>Age of head of household</b>	-0.04	0.01	8.78	1	0.00***	0.96
<b>Gender of head of household</b>	0.18	0.47	0.14	1	0.71	1.20
<b>Education of head of household</b>	-0.05	0.05	1.09	1	0.30	0.95
<b>Household size</b>	0.49	0.14	12.35	1	0.00***	1.63
<b>Occupation of household head</b>	-0.44	0.38	1.38	1	0.24	0.64
<b>Livestock keeping</b>	-1.15	0.67	0.05	1	0.83	0.86
<b>Main labour source</b>	-0.25	0.38	0.42	1	0.52	0.78
<b>Access to free training resources</b>	0.29	0.37	0.62	1	0.43	1.33
<b>Access to subsidised farm inputs</b>	-0.25	0.42	0.37	1	0.55	0.78
<b>Access to credit</b>	0.05	0.70	0.00	1	0.95	0.78
<b>Farm size</b>	0.12	0.10	1.32	1	0.25	1.12
<b>Trees mitigate climate change</b>	1.23	0.59	4.36	1	0.04**	0.29
<b>Farmer field schools (FFS)</b>	1.30	0.37	12.13	1	0.00***	3.68
<b>Farmer research groups</b>	-0.12	0.41	0.07	1	0.79	0.90
<b>Contact farmer approach</b>	0.82	0.34	5.87	1	0.02**	2.28
<b>Champion farmers</b>	0.57	0.40	2.00	1	0.16	1.76
<b>Intercropping with trees</b>	-0.40	0.35	1.35	1	0.24	0.67
<b>Constant</b>	-0.22	1.47	0.02	1	0.88	0.81

Source: field data

Key: Significant at \*=10%; \*\*=5%, \*\*\*=1%

A test of the full model versus a model with intercept (constant) only, was statistically significant indicating that the predictor variables differentiated adopters and non-adopters of CA (model's chi square statistic = 44.73,  $p = 0.00$ ). The model correctly predicted 75.3% of all responses. The Hosmer and Lemeshow test of goodness of fit (chi square = 5.73,  $p = 0.68$ ) was not significant at ( $p < 0.05$ ) implying that the model was a good fit. The model predicted that adoption of CA in Kenya was significantly influenced by the age of the household head, the household size, the perception by farmers that trees mitigated climate change, dissemination of knowledge through farmer field schools and the contact farmer approach.

The beta co-efficient of age of the household head was negative, meaning that the odds of adoption decreased by a factor of about 1 as a person got older. In a study on CA adoption carried out in Zimbabwe Mazvimavi (2011) notes that older farmers were weaker in physical strength and less able to participate effectively in farming. They were also more risk averse and less willing to adopt new farming technologies. An increase in the size of the household increased the odds of adoption by a factor of about 1.6. Larger households were likely to

have less labour constraints especially for CA operations like weeding which were labour intensive. Farmers' perceptions about the ability of trees to mitigate climate change were likely to increase adoption levels by a small margin of 0.2. Mc Carthy et al. (2011) report that improvements in Africa's farming systems through sustainable land management interventions such as CA and agroforestry can potentially increase the amount of carbon sequestered in the soil or above-ground as well as reduce carbon emissions. Long-term benefits to households from adopting such activities include increased yields and making the system more resilient to changes in climate. Knowledge dissemination through farmer field schools and contact farmer approach increased the likelihood of adoption by 3.7 and 2.3 respectively. Literature shows that farmers field schools and contact farmer extension approaches are participatory education and extension approaches that provide opportunities for farmers to learn by doing. They help teach farmers new information through demonstration, observation and information exchange and are useful strategies in spreading knowledge about CA (Sustainet EA, 2010).

**Table 3.3: Factors affecting adoption of CA in Tanzania**

<b>Variables</b>	<b><math>\beta</math></b>	<b>S.E.</b>	<b>Wald</b>	<b>df</b>	<b>Sig.</b>	<b>Exp(B)</b>
<b>Age of head of household</b>	-0.01	0.02	0.18	1	0.67	0.99
<b>Gender of head of household</b>	-0.07	0.93	0.01	1	0.94	0.93
<b>Education of head of household</b>	0.54	0.56	0.93	1	0.34	1.71
<b>Household size</b>	0.07	0.15	0.23	1	0.63	1.08
<b>Livestock keeping</b>	-1.27	0.80	2.56	1	0.11	0.28
<b>Access to training resources</b>	3.07	1.27	5.83	1	0.02**	21.45
<b>Access to subsidised farm inputs</b>	-0.97	0.89	1.19	1	0.28	0.38
<b>Access to credit</b>	0.63	0.83	0.56	1	0.45	1.87
<b>Perception about CA technology</b>	0.13	1.76	0.01	1	0.94	1.14
<b>Farm size</b>	0.05	0.04	1.74	1	0.19	1.05
<b>Trees mitigate climate change</b>	0.94	1.50	0.39	1	0.53	2.55
<b>Farmer field schools (FFS)</b>	0.82	1.29	0.40	1	0.53	2.27
<b>Farmer research groups</b>	-1.62	0.79	4.23	1	0.04**	0.20
<b>Contact farmer approach</b>	2.29	1.19	3.70	1	0.06*	9.85
<b>Champion farmers</b>	0.35	0.75	0.22	1	0.64	1.42
<b>Intercropping with trees</b>	-0.93	0.78	1.40	1	0.24	0.40
<b>Agro ecological conditions</b>	-2.49	1.26	3.94	1	0.05*	0.08
<b>Constant</b>	-6.52	2.75	5.61	1	0.02	0.00

Source: field data

Key: Significant at \*=10%; \*\*=5%, \*\*\*=1%

The overall model was statistically significant (chi-square = 59.983 at  $p < 0.005$ ) and correctly predicted 96.4% of all the responses. These results revealed that the factors that significantly ( $p < 0.05$ ) affected adoption of CA were access to training resources, knowledge dissemination through farmer research groups, contact farmers and agro ecological conditions. Access to training was likely to increase adoption by a factor of 21.5. Training resources are regarded as important in the improvement of knowledge and skills about CA and adoption of the same. Training should enable the transfer of information to farmers by use of methods that farmers easily understand and relate to. The cost of training is also an issue of concern since majority of farmers cannot afford to outsource training facilities and opportunities unless the costs are met by an external party. Mazvimavi (2011) emphasizes the importance of training farmers on all aspects of CA as critical to adoption and scaling up of the practices across Africa. In other studies, access to training is noted to be crucial to improving farmers' knowledge, skills and their ability to implement new interventions on their farms (Utting-Chamorro, 2005).

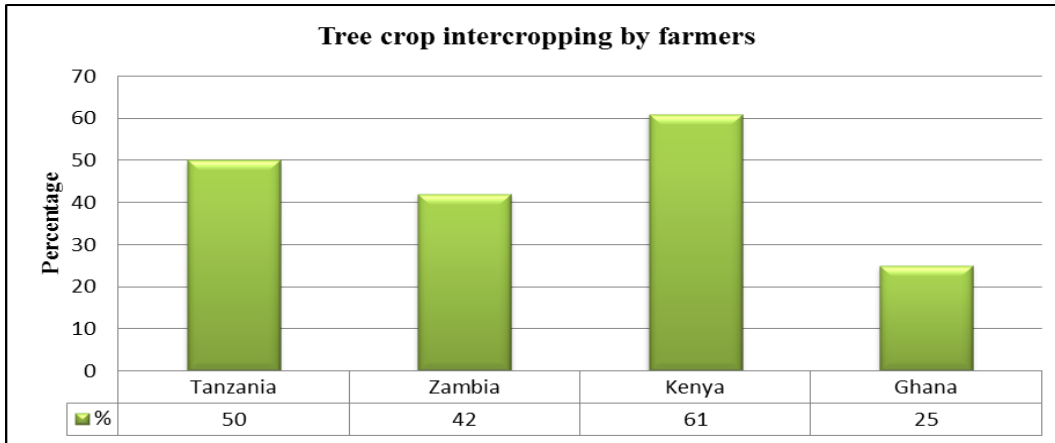
Farmer research groups were noted to negatively influence adoption. While it was not immediately clear during the research why this was so, the finding may have more to do with the way the groups were formulated and operationalised rather than the technique itself. Interaction with contact farmers was likely to increase the potential for adoption of CA by a factor of 9.9. A study in Tanzania finds that knowledge dissemination through extension approaches such as farmer research groups and contact farmers enhances the sharing of knowledge and experiences among farmers and between farmers and technical experts. Farmers who participate in knowledge dissemination sessions are better informed and more willing to adopt CA practices than those who do not (Owenya et al., 2012).

Agro ecological conditions were found to significantly but negatively influence adoption of CA. This implies that farmers in semi-arid/arid areas were more receptive of CA than those in humid areas. There is the possibility that some farmers in humid/sub-humid regions preferred not to adopt CA because of the potentially high incidence of weeds associated with such agro ecological zones. Weeding has been reported to be the most labour intensive operation related to CA adoption. Thombiono and Malo (2009) report that due to the wide range of agro-ecological conditions in Africa, there is need identification of and proper targeting of CA practices in order to boost adoption. For instance, the study notes that in humid/sub humid regions, a practical approach would be to increase mulch/cover crops so as to reduce weeds as an initial step to adoption.

### 3.2.4. Potential for scaling up CAWT

#### 3.2.4.1. Intercropping of trees and crops

As shown in Figure 3.3, intercropping of trees and crops was quite common in Kenya, Tanzania and Zambia but rather low in Ghana.



**Figure 3.3: Tree crop intercropping by smallholder farmers in four countries**

The main reasons cited as motivating intercropping trees with crops included provision of timber/poles, fuel wood, shade, wind breaking, fruits and mulch, and soil erosion control. Some farmers reported that trees provided them with income for domestic use, fodder for their livestock and aided in bee keeping. Factors affecting the scale of tree establishment by farmers included agro ecological conditions, land sizes, type of land ownership and the types of implements used on the farm. Farmers who did not intercropping trees with crops gave varying reasons, some of which were the long period needed for trees to mature, rooting systems unfavourable to crops, lack of seedlings, lack of knowledge on management of trees, and allelopathic effects on crops and animals. In Ghana, farmers had to contend with illegal chain saw operators who were given access to farm trees by an unfavourable tree tenure policy. Nevertheless, these findings provide a positive outlook for the scaling up of CAWT, as the agroforestry component appears to have a fair level of acceptance by farmers. There is however need for more information on which tree species and management options are appropriate for specific regions, taking into account that farmers are likely to plant trees if they consider them beneficial.

### 3.2.4.2. Factors influencing intercropping of trees with food crops

Given the importance of trees in efforts towards scaling up CAWT, further information was sought on factors that influenced tree crop intercropping by farmers. Factors postulated to influence tree crop intercropping differed slightly across countries due to varying biophysical, socio economic and institutional conditions.

**Table 3.4: Factors influencing intercropping of trees with food crops in Tanzania**

Variables analysed	$\beta$	S.E.	Wald	df	Sig.	Exp(B)
Age of head of household	0.01	0.01	1.57	1	0.21	1.01
Gender of head of household	-0.12	0.40	0.09	1	0.76	0.89
Education of head of household	0.06	0.20	0.07	1	0.79	1.06
Household size	0.05	0.05	1.31	1	0.25	1.05
Livestock keeping	0.52	0.31	2.77	1	0.10	1.68
Access to training resources	0.21	0.27	0.61	1	0.44	1.23
Farm size	-0.03	0.01	5.30	1	0.02**	0.97
Climate change mitigation	0.71	0.27	6.64	1	0.01**	2.03
Maize yield per acre	0.00	0.00	1.03	1	0.31	1.00
Agro ecological conditions	-1.71	0.29	33.95	1	0.00**	0.18
Constant	-0.91	0.79	1.32	1	0.25	0.40

Source: field data

Key: Significant at \*=10%; \*\*=5%, \*\*\*=1%

The overall model summary was significant at  $p < 0.05$  and correctly predicted 69% of all the responses. Farm size was found to be significantly and negatively related to adoption. Farmers with large sizes of land were less likely to intercrop trees with food crops as compared to those with smaller land sizes. Large pieces of land were likely to be used for fallow agriculture while farmers with smaller pieces of land were interested in intensive farming to better utilise the scarce land resources they have. This finding is similar to that of Kabwe et al. (2009) who found that land limitation enhances adoption of agroforestry.

The perception that intercropping trees with food crops could mitigate climate change effects significantly and positively influenced adoption. Farmers in regions that were experiencing climate variations could have perceived it beneficial to intercrop trees with their food crops in order to ameliorate the situation. FAO (2007) found that in addition to supplying wood and non-wood tree products, agroforestry restored soil fertility, enhanced biological diversity, and improved microclimatic conditions by buffering winds, regulating the water table and providing shade to crops and animals. Agro ecological conditions were

found to affect adoption significantly but negatively, implying that farmers in drier regions were more likely to intercrop trees with food crops in comparison to those in wetter regions. The effects of trees in improving soil fertility, providing mulch, reducing evapo-transpiration and regulating micro climatic conditions have been documented widely and this may be what motivated farmers to inter crop trees and food crops.

**Table 3.5: Factors affecting intercropping of trees with food crops in Ghana**

<b>Variables analysed</b>	<b>β</b>	<b>S.E.</b>	<b>Wald</b>	<b>df</b>	<b>Sig.</b>	<b>Exp(B)</b>
<b>Age of head of household</b>	0.09	0.22	0.17	1	0.68	1.10
<b>Education of head of household</b>	-0.41	0.36	1.26	1	0.26	0.67
<b>Livestock keeping</b>	2.70	0.91	8.71	1	0.00***	14.81
<b>Access to free training</b>	1.57	0.91	2.95	1	0.09*	0.21
<b>Farm size</b>	0.03	0.34	0.01	1	0.92	1.03
<b>Climate change mitigation</b>	-1.46	0.98	2.23	1	0.14	0.23
<b>Main labour source</b>	-0.84	0.77	1.20	1	0.27	0.43
<b>Access to credit</b>	0.29	0.95	0.96	1	0.76	1.34
<b>Subsidised inputs</b>	0.52	1.09	0.23	1	0.64	1.68
<b>Constant</b>	0.82	2.98	0.08	1	0.78	2.26

Source: field data

Key: Significant at \*=10%; \*\*=5%, \*\*\*=1%

The overall model was significant at  $p < 0.05$  and correctly predicted 86.8% of all observations. The results indicated that livestock keeping and access to training significantly influenced tree crop intercropping in Ghana. An increase in a unit of livestock increased the odds of adoption of agroforestry by almost 15 times. This could be explained by the fact that in some cases, livestock depend on trees for fodder and shade. Studies elsewhere support this assertion. Neupane et al. (2002) indicated that livestock ownership positively influenced adoption of agroforestry technologies. Fodder tree technologies were more likely to be adopted by households with cattle, goats and sheep. Mwangi et al. (1996) in a study conducted in Tanzania found that the number of cattle owned had a positive influence on adoption of agroforestry technologies. Access to training opportunities significantly influenced adoption as a unit increase in the number of trained farmers led to the likelihood of adoption increasing by a factor of 0.2. Provision of training is noted as essential in enhancing farmers' understanding of agroforestry technologies and guiding them on required inputs and management regimes.

**Table 3.6: Factors influencing intercropping of trees and food crops in Kenya**

Variables analysed	$\beta$	S.E.	Wald	df	Sig.	Exp(B)
Age of head of household	0.01	0.01	0.46	1	0.50	1.01
Gender of household head	0.66	0.41	2.57	1	0.11	1.94
Education of head of household	-0.07	0.04	2.67	1	0.10	0.94
Livestock keeping	-0.07	0.59	0.01	1	0.91	0.94
Access to training resources	0.96	0.32	8.71	1	0.00***	2.60
Farm size	-0.16	0.09	3.20	1	0.07*	1.18
Climate change mitigation	0.93	0.47	3.97	1	0.05*	0.40
Occupation of household head	-0.47	0.36	1.76	1	0.19	0.62
Access to credit	-0.49	0.61	0.66	1	0.42	0.61
Subsidised inputs	0.26	0.38	0.48	1	0.49	1.30
Constant	-0.46	1.29	0.13	1	0.72	0.63

Source: field data

Key: Significant at \*=10%; \*\*=5%, \*\*\*=1%

The overall model was found to be significant at  $p < 0.05$  and correctly predicted 69.4% of all observations. The variables that significantly influenced adoption of agroforestry were access to training, farm size and perception of agroforestry as able to mitigate climate change. Access to training and farm size were likely to increase the potential for adoption of agroforestry by factors of 2.6 and 1.2 respectively while perception of agroforestry as mitigating climate change increased adoption by 0.4 times. As discussed under Tables 4 and 5, the explanations for these particular findings are similar to those previously stated.

#### 3.2.4.3. Constraints to adoption of CA and CAWT

Farmers identified various factors that constrained their adoption of CA and CAWT practices. Financial constraints hindered farmers' ability to hire labour and purchase inputs such as tree seedlings and fertilizers. Lack of technical knowledge about CA and its implementation affected farmers' perceptions about the intervention and adoption. Some concepts were not clear to farmers and few had information about how to access the different CA implements. The labour intensive nature of CA practices especially weeding was cited as an impediment to adoption. Farmers who had insufficient family labour and could not afford to hire labour during peak periods were the most affected. Lack of tree seedlings was also reported to be a hindrance to adoption of CAWT. Some farmers noted that they were not able to access seedlings and that sometimes institutions that distributed them sold them, making them unaffordable to some farmers. Others were not aware which tree species were suitable for their farms and agro ecological zones. Illegal logging especially in Ghana was noted as a deterrent to tree establishment. Small farm sizes obstructed some farmers from planting

trees in their farms. They indicated that trees competed for space, water and nutrients with food crops while others had allelopathic effects on the soil and crops. Difficulties in managing over grown trees with regards to pruning overgrown branches were also cited as obstacles to CAWT adoption. Other barriers included concerns that trees encouraged the harbouring of harmful animals such as snakes as well as pests and disease attacks.

### **3.3 Conclusions**

The findings of the baseline studies reveal that although CA is not new in Africa and some aspects of it have been practised in some countries for decades, the CA concept in its comprehensive form is still not familiar to most farmers. This study found that adoption of CA is still not wide spread and is at its infancy stages. Like elsewhere in Africa, farmers in the study countries rarely adopted all three components of CA, preferring to adopt one or two components depending on their specific circumstances. Minimum tillage was the least adopted CA principle in Ghana, Kenya and Tanzania while crop rotation was the most widely adopted in the three countries. Contrastingly, minimum tillage was widely adopted in Zambia due to the well-known 'basin' planting technique. Cover crops were not preferred due to the fear of free grazing. As such, adoption of CA depends on specific farmer, region and country circumstances and may therefore not be adopted as a blanket or a one size fits all intervention.

Farmers indicated that weeding was the most labour constraining farm operation and this may partly explain why adoption of one or two components of CA was preferred over adoption of all three CA components. The finding also points towards insufficient labour supply. Even though majority of the households reported that family labour was the most popular source of labour, it may not have been sufficient especially during peak periods and few farmers could afford to complement it with hired labour or purchase herbicides to eliminate weeds. However, the use of herbicides needs to be looked at in relation to environmental conservation goals as their constant use may eventually destroy the very natural resource base that CA seeks to protect. With the exception of ploughing, most farming operations were conducted by both men and women. While this may suggest that gender was not a key determinant of adoption of CA, there is need for further empirical research into the matter. Moreover, farmers reported that CA technologies such as rippers were not readily available or affordable by some and this affected adoption. Some farmers were also stuck to their routines with regards to the use of conventional tilling technologies and were not willing to switch to recommended technologies. Attitudes and perceptions among farmers ideally take long to change but with training and exposure some progress can be made. CA promotional strategies such as the use of seminars, farmer field schools



and contact farmers were found to be efficient tools in knowledge dissemination and could be applied to promote a wider understanding of CA. Nevertheless, printed material was reported as the least preferred knowledge dissemination strategy and there is need to establish why this was so. Printed material may require to be presented in local languages, easy to understand and illustrative in order to raise farmers' interest.

Adoption of CA was found to be influenced by various factors like the age of the household head, household size, access to training resources, knowledge dissemination mechanisms applied (e.g. farmer field schools and contact farmer approach) and farmers' perception of CA as potentially mitigating climate change. Older farmers were found to be less receptive of new ideas and risk averse whilst household size which was a proxy for labour availability, was indicative of farmers' inability to afford hired labour especially during peak periods such as ploughing, planting, or weeding. Access to training resources helped farmers acquire knowledge about CA and general farming information. Information exchange and interactions between farmers were also preferred modes of communicating CA to farmers as shown by their support for knowledge dissemination strategies such as farmers' field schools and contact farmer approach. The results also noted that concerns about climate change were real among farmers given their indication that they were willing to adopt CA if they perceived it as mitigating climate change.

The potential for scaling up CAWT is also brought out by farmers' support for intercropping trees and crops/agroforestry. The study found that the key determinants of farmers' adopting agro forestry were farm size, perception of agroforestry as mitigating climate change, agro ecological conditions, livestock keeping and access to training resources. Farmers with smaller land sizes were the most likely to adopt agroforestry because they intensively used their land. Agro ecological conditions that favoured the planting of certain trees also encouraged adoption of agroforestry. The planting of fertilizer or leguminous fodder trees was largely preferred by farmers who kept livestock such as cattle, goats and sheep. Access to training about tree species and their management was a boost to adoption. Climatic variations affecting farmers' productive capacity influenced their perception of trees and this encouraged adoption since farmers felt that trees would help ameliorate micro climatic conditions on their farms. These findings give impetus for scaling up of CAWT with some degree of caution since farmers' adoption decisions are affected by varying socio economic, institutional, demographic and bio physical factors.

Targeting of CAWT interventions will need to take into account the specific local conditions of farmers in different countries. Furthermore, more research is needed on adoption and scaling up of both CA and CAWT to shed light on the following questions among others:

which components of CA are suitable for which contexts? Which tree species and management practices are suitable for which regions or agro ecological zones? Does gender have an influence on adoption of CA? How can extension messages be packaged for greater effectiveness? Which groups of farmers are at a better position to champion and adopt CA and CAWT? How do socio economic, institutional, political, demographic, bio physical influence decision making processes on adoption of all or certain CA components? What are the costs and benefits of CA and which groups of farmers would benefit the most from adopting CA or CAWT?

## **4. POLICY INCENTIVES FOR SCALING UP CONSERVATION AGRICULTURE WITH TREES IN TANZANIA, KENYA, GHANA AND ZAMBIA**

### **4.1 Introduction and methods**

The objective of this output was to assess policy factors that influence scaling up of agroforestry based CA technologies and opportunities for policy reforms and institutional strengthening. MSc students were engaged in Kenya and Tanzania while FORIG scientists conducted the study in Ghana. Consultants were also hired to conduct a quick analysis in Tanzania and Zambia. The main sources of literature were relevant policy documents of governments, relevant journal papers, working papers, reports, books, and electronic media. Professionals in the agricultural and related fields were also consulted to shed light on subjects requiring further insight. The discussions and conclusions made are based on available literature and the authors' objective views. After country studies were finalized a consultant was identified to conduct a cross synthesis and also synthesize pertinent policies by regional bodies.

### **4.2 Results and discussion**

The findings of this study are presented in two ways: in form of specific country policy frameworks conducive for scaling up CAWT and as a regional policy framework analysis of the potential of scaling up CAWT in Africa, with special attention paid to the AU – NEPAD led CAADP programme.

#### **4.2.1. Country Profiles and Existing Policy Frameworks for Scaling Up CAWT in the Four Project Countries**

##### **4.2.1.1. Ghana**

Ghana is located between latitudes 4°44' and 11°15'N, and longitudes 3°15'W and 1°12'E. The country shares borders on the east with the Republic of Togo, on the north with Burkina Faso and to the west with Ivory Coast. Ghana's population reached 24.2 million in 2010, an increase of 28% from 2000, with an average annual growth rate of 2.4%. The Gross National Income (GNI) per capita is US\$ 1,283 but the Government aims to increase this to US\$3,000 by 2020. Ghana has a total land area of 23.9 million hectares of which 15.7 million hectares lies within the savanna zone (SZ) in the north while the remaining 8.2 million hectares lies within the high forest zone (HFZ) in the south of the country. About 57% of the total land

area is classified under agricultural use. Ghana's agricultural sector is important to the economy, currently providing approximately 30% of the country's GDP, 65% of employment mainly in the rural areas, and 50% of exports. Agriculture is predominantly on a smallholder basis with about 90% of farm holdings being less than 2 hectares in size. The agricultural sector is responsible for meeting over 90% of the food needs of the country. Poverty is pervasive in Ghana and is viewed as the main underlying socio economic cause of land and soil degradation as it limits the ability of the poor to adopt sustainable farming practices.

Most farmers in Ghana are not aware of the linkage between poor agricultural practices and environmental degradation. With an estimated 64% of the natural wealth of Ghana locked up in crop lands, there is need for more focused attention to address poor agricultural land management (MOFA, 2011). Agroforestry and CA are among the interventions being promoted to enhance sustainable farming (Boahen et al., 2007; FAO, 2007). Therefore, conservation agriculture with trees (CAWT) and the prudent management of agrochemicals and drainage are considered crucial in sustaining the natural resource base. CA is not a new concept in Ghana (Boahen et al., 2007), but the term CAWT is, although the actual concept has long been in practice in the country. In Ghana as elsewhere in West Africa, farmers incorporate trees within agricultural cropping systems to provide fruits, firewood, poles, shade for crops, timber and to improve soil fertility and protect the environment. For example, in cocoa and coffee agroforestry systems, trees are incorporated to provide shade as well as timber and firewood.

Several agroforestry interventions and CA practices in Ghana have included measures that depict CAWT. For instance, indigenous practices such as home gardens incorporate trees like *Albizia* and *Morinda lucida*. Home gardens are important for additional food supply (*Manihot esculenta* (cassavas), *Musa spp*), fruits (*Mangifera indica* (mangoes), *Citrus spp* (oranges), and *Psidium guajava* (guavas)), medicinal uses (*Morinda lucida*), fuel wood (*Acacia spp*), shading and ornamental or fencing functions. Other interventions include the use of *Gliricidia sepium*, *Leucaena spp*, and *Faidherbia albida* in improving soil fertility in maize, cowpeas, and other cropping systems in the northern and south western parts of the country. Additionally, some programmes and projects involve the development and promotion of sustainable land management systems that support soil conservation and agroforestry activities that involve CAWT. Examples include the Forest Resources Creation Project and the Gwira-Banso Joint Forest Management project promoting agroforestry and soil fertility technologies that include trees to improve soil fertility.

The review of existing policies indicates that adequate frameworks exist that could support the scaling up of CAWT in Ghana. These policies were selected based on their ability to

promote one or more principles of conservation agriculture, although that may not have been their primary goal during formulation and implementation. They include:

### *1. The Food and Agriculture Sector Development Policy*

This is the government's policy to guide development and interventions in the agriculture sector. FASDEP II seeks to enhance the environment for all categories of farmers, while targeting poor, risk prone and risk-averse producers. Based on the role of agriculture in the national development framework, the objectives of the food and agriculture sector policy include food security and emergency preparedness, sustainable management of land and the environment, application of science and technology in food and agricultural development and improved institutional coordination.

### *2. Crop Development Policy*

The goals of the crop sub sector development policy are to enhance integrated food, horticultural and industrial crop production, to promote the competitiveness and profitability of crops through access to improved technological packages for increased productivity, and to ensure sustainable management of the environment in crop production systems. The guiding principle is to develop the integrated use of natural resources for increased productivity of the crop sub sector in partnership with appropriate government and non-governmental agencies.

The major industrial crops such as cashew, citrus, cotton, coconut, oil palm, and rubber share similar constraints, which include unavailability of high yielding planting material, poor agronomic practices and cultivation of small holdings. The objectives in the medium term are to increase the availability of improved planting material, boost adoption of improved agronomic practices and expand the average farm size per holder. The policy proposes to achieve this by: (i) supporting production of certified seeds/planting materials and increasing farmer usage through intensification of awareness campaigns, (ii) intensifying dissemination of updated crop production technological packages, (iii) facilitating the development of high-yielding, disease and pest-resistant varieties and increasing supply of certified planting material (iv) ensuring that operators of urban agriculture are reached with the needed information technology and inputs.

### *3. National Irrigation Policy*

Ghana's irrigation policy (and the strategy for its implementation) is designed to open up the investment space for intensified and diversified irrigated crop production in situations where there is a clear comparative advantage. The policy is designed to accomplish this by addressing four key concerns. These are: (a) low agricultural productivity and slow rates of

growth, (b) constrained socio economic engagement with land and water resources, (c) environmental degradation associated with irrigated production, and (d) lack of irrigation support services. The objective of the Irrigation Policy is to attain sustainable growth and heightened performance of the irrigation sector. The Policy targets national food security, intensified and diversified production of agricultural commodities, increased livelihood options, optimum natural resource use, reduced negative environmental impacts, and increased investments in irrigated production.

#### *4. The Soil Fertility Management Plan, 1998*

This plan encourages the sustainable use of land by promoting crop rotation, agroforestry and soil and moisture conservation practices.

#### *5. National Agroforestry Policy, 1986*

In Ghana, agricultural policies and practices have gradually shifted to embrace introduction and intensification of modern agroforestry practices as outlined in the National Agroforestry Policy of 1986. The overall objective of the policy is to promote agroforestry practices for sustainable land use.

#### *6. The National Land Policy*

The National Land Policy provides a framework for addressing the problems and constraints associated with sustainable land use and security of tenure to maintain a stable environment for the country's social economic development. The Land Policy aims at advancing the judicious use of Ghana's land and all its natural resources by all sections of the Ghanaian society in accordance with sustainable resource management principles and by maintaining viable ecosystems. Key policy provisions include guaranteeing security of tenure and protection of land rights, upholding sustainable land use, and promoting land productivity and conservation. The policy states that the supply of land will be sustained by all appropriate methods, including soil conservation, improving soil productivity, control of desertification, and rehabilitation of degraded land areas. Other forms of incentives will be provided for the adoption of land use methods or practices that sustain land capability or conserve land.

#### *7. Extension Policy*

The vision of the extension policy is in the medium term, to have established an efficient and demand-driven extension service in a decentralised system through partnership between the government and the private sector.

### *8. National Water Policy*

The National Water Policy aims at enhancing the efficient development and management of the nation's water resources. Based on the principle of Integrated Water Resources Management (IWRM), the policy particularly encourages the sustainable exploitation, utilisation and management of water resources to ensure full socio economic benefits to present and future generations, while conserving biodiversity and the environment. The policy among other measures, seeks to ensure the availability of water in sufficient quantity and quality for different purposes, including agricultural use to sustain food production and security. It also encourages the coordination of water resource planning with land use planning, and participatory decision making at the lowest appropriate level. The policy further promotes the development and use of appropriate technologies for sustainable water resources use and management.

### *9. The Forest and Wildlife Policy*

The 1994 Forest and Wildlife Policy (FWP) provides the strategic framework for conservation and sustainable development of forest and wildlife resources in the Ghana. The objective of the policy is clear on the benefits to be derived from conservation and management of forests and wildlife resources. The policy seeks to optimise resource utilisation, to ensure future supplies of wood and non-wood products, and to manage national forests and wildlife resources with a view to maintaining the ecological balance and diversity of the natural environment. The FWP emphasizes the importance of conservation. Among the guiding principles that highlight the need for conservation are: (1) the rights of people to have access to natural resources for maintaining a basic standard of living and their concomitant responsibility to ensure the sustainable use of such resources, (2) the wise use of forest and wildlife resources as part of an integrated land use policy, and (3) the need to incorporate traditional methods of resource management in national strategies where appropriate.

### *10. The National Environment Policy*

The National Environment Policy aims at improving the living conditions and the quality of life of present and future Ghanaian generations. It seeks to ensure reconciliation between economic development and natural resource conservation by promoting sound management of natural resources. Key issues in the policy include land, forestry, and water management. Specifically, the policy seeks to (1) maintain ecosystems and ecological processes essential for the functioning of the biosphere, (2) adequately protect humans, plants, animals, and their biological communities and habitats against harmful practices and preserve biological diversity, (3) reduce and/or eliminate pollution and nuisances, and (4)

integrate environmental considerations in sectoral, structural, and socio economic planning at the national, regional, district and grassroots levels.

#### **4.2.1.2. Zambia**

Zambia is a large landlocked country which covers an area of 752, 614km<sup>2</sup>. The population grew by 2.8 per cent during the 2000s and totaled 13 million in 2010, giving it a population density of only 17 persons per km<sup>2</sup>. In the last 10 years, the country's economy has significantly improved. With macroeconomic and public sector reforms initiated in the 1990s and propelled by rising copper prices, annual economic growth averaged 4.8 % over the period 2002 to 2005 and increased to 6.1 % between 2006 and 2009. National poverty levels have reduced somewhat since 1998, but remain high with 64 % of the population ranked as poor and 51 % as extremely poor in 2006. Poverty in rural areas is significantly higher than in urban areas (IFAD, 2011b). Agriculture is the main source of income and employment for more than 60% of the population and thus accelerated growth in the sector is important in reducing both poverty and the dependency on the mining sector. The smallholder farming sector numbers approximately 1.1 million households, over 20 % of which are female headed. These households cultivate on average 1.5 hectares of land, generally using low-input, hand hoe technology and relying primarily on family labour. They produce principally for household consumption, although about one-third sell some of their production. At the other extreme, about one quarter suffer chronic food insecurity and require long term social protection.

Zambia's overall agricultural production system is dominated by maize, which is grown by 80 % of farming households (Thurlow et al, 2008). Nonetheless, low population densities mean that for many smallholder farmers, agricultural markets are distant, uncompetitive and poorly remunerated, creating little incentive for increased production. Further, the plentiful availability of arable land encourages majority of smallholder farmers to expand the area under cultivation rather than intensify the production system. Lack of education (over 70 per cent of smallholder farmers only possess primary level education) and entrepreneurial skills, high dependency rates and seasonal labour constraints undermine farmers' productive capacity and so do farmers' lack of financial assets. Other major challenges include low farm productivity and continued yield decline as a result of soil degradation associated with inappropriate farming practices. HIV/AIDS as well as high costs of external inputs and the vagaries of climate change continue to negatively impact agriculture in Zambia. The Sixth National Development Plan (SNDP) for 2011 to 2015 states that "agriculture remains the priority sector in achieving sustainable economic growth and reducing poverty in Zambia."



In 1999, the Government of Zambia, through the Ministry of Agriculture and Cooperatives (MACO) declared Conservation Farming (CF) and related technologies a priority for promotion by both MACO and the various partner institutions, such as the Conservation Farming Unit (CFU), Golden Valley Agricultural Research Trust (GART), Land Management and Conservation Farming Programme (LM&CF), the Agriculture Support Programme (ASP) and the World Agroforestry Centre (ICRAF) in order to address the issue of low farm productivity and sustainable production. The vision was to scale up CA among smallholder farmers as a sustainable approach to increase farm productivity and sustainable production. So far, more than 160,000 farmers have extended their conservation farming practices to include the cultivation of food crops within agroforests of *Faidherbia* trees over an area of 300,000 hectares. The Zambian Government emphasizes and supports the need to conserve natural resources through sector, national, and international level policy frameworks. The key national level policies include:

### *1. The Agriculture Policy*

The goal of the Agriculture Policy is to promote sustainable agricultural production in order to ensure food security, income generation, creation of employment opportunities and reduction in poverty levels. It also aims at maximizing the sector's contribution to the GDP. The policy will be realised through enhanced food security, promotion of sustainable farming practices, increasing incomes and employment creation, contribution to industrial development and increased exports. To achieve these goals, some designed programmes include: (i) strengthening and monitoring the liberalisation of markets and facilitating private sector development, (ii) promoting and securing access of agricultural products to both local and international markets, (iii) diversification of agricultural production and utilisation, (iv) strengthening and facilitating the provision of agricultural services, (v) reviewing and realigning institutional and legislative arrangements, (vi) facilitating availability of and accessibility to land for agriculture and development of infrastructure in potentially productive agricultural areas, (vii) promotion of sustainable and environmentally sound agricultural practices, (viii) and promoting irrigation development (Nyambe and Fielburg, 2009).

### *2. The National Environment Policy*

The National Policy on the Environment (NPE) serves to rationalise the various priorities and define a comprehensive policy for managing environmental and natural resources in harmony with the national development policy. The NPE is envisaged as a comprehensive approach to environmental management. The overall goal of the policy is to promote sustainable social and economic development through the sound management of the

environment. Its goals are expected to be achieved through programmes on natural resources management and the environment. The policy seeks to promote efficient utilisation and management of natural resources, facilitate the rehabilitation and management of essential ecosystems, and ecological processes. In addition, the policy will enhance public awareness on the importance of sound environmental management and promote cooperation between government, local communities, women groups, NGOs and the private sector in the management of natural resources.

### *3. National Forestry Policy*

The National Forestry Policy aligns the forestry sector to current trends in forestry and to the necessity of meeting the national strategies as enshrined in the National Policy on Environment, the MDGs and other global conventions and treaties to which Zambia is a signatory. The policy aims to accelerate sustainable management of the country's forest resources and to meet the growing local needs for fuel wood, fodder, timber and non-wood forest products (NWFPs). It operates on the principle of 'Joint Forests Management', which encourages participatory and sustainable forest management through the active participation of local communities, traditional institutions, and other stakeholders at all levels of decision making, implementation, monitoring and evaluation. Further, the Forestry policy states that deforestation is a major factor in soil erosion, siltation of lakes, rivers, dams and other water bodies, loss of biodiversity and climate change. It seeks to enhance the functional role of forests in carbon sequestration and advocate for private investments in non-wood forests products, carbon forests, farm forests, plantation forestry and homestead forestry. The policy also backs the definition of stakeholder roles, resource tenure, cost and benefit sharing, and investment and development of forest industries (Government of Zambia, 2009).

### *4. National Water Policy, 1994*

Water sector reforms in Zambia started with the realisation that service provision was inadequate as was protection, conservation, development and management of water resources. The National Water Policy was therefore adopted in 1994 with the following key policy strategies: (i) recognising the important role of the water sector in the overall socio economic development of the country, (ii) vesting control of water resources in the country under state control, (iii) promoting water resources development through an integrated management approach, and (iv) providing adequate, safe, and cost effective water and sanitation services with regard for environmental protection. It further purposes to define clear institutional responsibilities of all stakeholders in the water sector for effective management and co-ordination (Nyambe and Fielburg, 2009).

### *5. Irrigation Policy*

In reforming irrigation, the Government of Zambia has put in place an irrigation policy and devised technological and investment procedures with objectives such as: (i) to promote appropriate and sustainable irrigation technologies and techniques for small scale farmers, (ii) to establish accessible, efficient, transparent and service oriented demand-driven institutions, (iii) to facilitate well regulated long term Water Rights, (iv) to ensure equitable access to irrigation resources by all irrigators through a transparent and well enforced irrigation regulatory framework, (v) to encourage and promote affordable and accessible credit mechanisms, (vi) to put in place an irrigation sector that is well served by accessible communications infrastructure, and (vii) to promote conducive conditions for increased profitability from irrigated farming (Nyambe and Fielburg, 2009; MFNP, 2006; MACO, 2004).

### *6. Draft Land policy, 2006*

The Land Policy seeks to develop a strategy for linking natural resource management with land administration and management. It aims at enhancing coordination and communication among public and private sectors and creating incentives for sustainable land management. The policy states that all socio economic activities involving land use will have to conform to prescribed natural resource conservation principles and guidelines, while promoting land conservation measures in leasing conditions. In order to implement the policy, the government commits to adopt a strategy that involves all stakeholders in a participatory and inclusive manner. Implementation of the policy's measures will require the ministry of land to take a leading role and to encourage institutional collaboration with land related institutions, as well as strengthening enforcement of public land use laws and regulations (Government of Zambia, 2006).

#### **4.2.1.3. Tanzania**

Tanzania has a total area of 945,239 km<sup>2</sup> and is the biggest country in East Africa. Tanzania is located between latitude 1<sup>o</sup> and 12<sup>o</sup> South and longitude 29<sup>o</sup> and 41<sup>o</sup> East. The country is bordered in the north by Kenya and Uganda, in the east by the Indian Ocean, in the south by Mozambique and Malawi and in the west by Rwanda, Burundi, the Democratic Republic of the Congo and Zambia. The population is currently estimated at 43 million people increasing at an annual rate of 2.8% (URT, 2002). The economy of Tanzania like with many other countries south of the Sahara mainly depends on agriculture which accounts for about 24.1% of the GDP (URT, 2011). About 74% of its population lives in the rural areas with agriculture as the main livelihood activity. The annual production of food crops ranges between 10-12 million tonnes, meeting about 95 per cent of the national food requirements. At household level, the sale of agricultural products remains an important income generating activity accounting for about 70% of rural households' incomes. Other sectors of the economy that

contribute substantially to the GDP include industry and construction (22.4%), trade (12.1%), transport and communication (7.2%), business transactions (8.8%), and administration which contribute 8.8%.

Tanzania has been undergoing some major economic reforms in the last two decades in its efforts towards socio economic development. The implementation of these policies and economic reforms by the government since the mid-1980s has resulted in a steady growth of the economy. The GDP has improved considerably from a rate of 1.5% in 1983, to an average of 3% in the 1990s and to 7% in 2010 (URT, 2007). However, the modest achievements in the economy are yet to be reflected in the agricultural sector as it has only been growing at an average rate of 4% per annum over the last decade. Land degradation has been observed as one of the factors limiting agricultural production. The primary factors contributing to land degradation include deforestation, overgrazing and inappropriate farming practices like conventional tillage. Climate change is also noted to have negative impacts on agricultural production in the country. Tanzania is listed among thirteen African countries likely to be worst affected by the impacts of climate change impacts and having the least adaptive capacities (Thornton et al. 2002).

Among the measures which have been brought forward to address land degradation and mitigate climate change include the adoption of environmentally friendly crop production interventions such as CA and agroforestry. Unlike neighbouring Zambia and Malawi, CAWT is a new concept in Tanzania, although aspects of it have been practised for ages. Nevertheless, several interventions both in CA and agroforestry depict CAWT. For example, some of the indigenous technologies like the Chagga home gardens incorporate large trees such as *Albizia spp* and *Grevillea robusta*, as well as banana and coffee canopies, fodder, herbs, and grasses. Others include the use of *Faidherbia albida* in improving soil fertility in maize in Mbarali district, Ngitili in Shinyanga among others. Other programmes involved in promoting sustainable land management systems supported soil conservation and agroforestry activities that involved laying contour bunds planted with grass and/or multipurpose trees which included *Grevillea robusta*, *Sesbania sesban*, *Calliandra calothyrsus* and *Leucaena spp*.

In Tanzania, several sectoral policies support the scaling up of CAWT as follows:

1. *National Agricultural Policy*

The National Agricultural Policy revolves around the goals of developing an efficient, competitive, and profitable agricultural industry that contributes to the improvement of the livelihoods of Tanzanians and the attainment of broad based economic growth and poverty reduction. The policy promotes integrated and sustainable management of natural resources

and identifies the need for developing mechanisms for linking the agricultural sector and environmental protection. It recognises the vulnerability of agriculture to the effects of climate change, which may be attributed to unsustainable farming methods, deforestation, and land clearing. The policy advocates for increased awareness of sustainable environmentally friendly crop husbandry practices and the scaling up of activities that enhance carbon sequestration, for instance agroforestry and CA.

### *2. Agricultural Sector Development Strategy, 2001*

The primary objective of the Agricultural Sector Development Strategy (ASDS) is to create an enabling and conducive environment for improving productivity and profitability of the agricultural sector as the basis for ensuring household food security, improved farm incomes and rural poverty reduction in the medium and long term. ASDS provides a basis for action by both the public and private sector to support Tanzania's efforts to stimulate agricultural growth and alleviate poverty. The ASDS points out that soil and water management practices must be improved in order to reduce the risks of rainfall unpredictability and the recurrence of droughts and floods. The strategy stipulates that the government in close collaboration with the private sector will coordinate efforts to improve and maintain soil fertility through increased use of organic fertilizers, land and environmental degradation control, and efficient water utilisation through better management practices.

### *3. The National Irrigation Policy, 2010*

The main objective of the National Irrigation Policy is to promote sustainable availability of irrigation water and its efficient use for increased crop production and profitability that will contribute to food security and poverty reduction. The policy identifies the need to streamline crosscutting issues such as land, environment, HIV/AIDS and gender. The policy will ensure the establishment of agricultural land use plans and promotion of appropriate farming systems that conserve soil and water. The policy notes that inappropriate land use practices can result in accelerated runoff, reduced ground water recharge, soil erosion, increased sediment transportation by rivers, and silt accumulation in reservoirs and irrigation systems. The policy therefore proposes that the government should ensure proper land use practices and environmental protection in all irrigation interventions in accordance with the Environmental Management Act (EMA) of 2004.

### *4. The National Environmental Policy, 1997*

The National Environmental Policy provides a framework for environmental management and conservation in Tanzania. The overall objectives of the policy are to: (i) to ensure sustainable and equitable use of resources without degrading the environment or risking health and safety, (ii) to prevent and control the degradation of water, vegetation, and air

which constitute the essential life support systems,(iii) to conserve the biological diversity of unique ecosystems of Tanzania,(iv) to improve the condition and productivity of degraded areas, (v) to raise public awareness,(vi) to promote individual and community participation, and (vii) to promote international cooperation. With regards to the agricultural sector, the policy emphasizes soil erosion control and minimisation of encroachment into forests, woodlands, wetlands and pastures. It also advocates for strengthening of environmentally sound use of agrochemicals to minimise pollution of water bodies.

### *1. The Land Policy, 1995*

The overall objective of the Land Policy is to promote and ensure a secure land tenure system, to encourage the optimal use of land resources and to facilitate broad based socio economic development without upsetting or endangering the ecological balance of the environment. The policy promotes equitable distribution and access to land by all citizens and recognises land rights, especially customary rights of smallholders. The Land Policy requires that the village land use plans be used as a tool for implementing policies for better land use management and sustainable development.

### *2. The National Water Policy, 2002*

The overall objective of the water policy is to develop a comprehensive framework for sustainable management of the national water resources. Tanzania's agriculture is at risk in part because of the unpredictability of rainfall and the subsequent calamities of droughts, floods or poor harvest. The water policy endeavours to ameliorate this problem by explicitly recognising the role of irrigated agriculture in enhancing agricultural production and food security in the country. The policy seeks to address cross-sectoral interests in water and watershed management through integrated and participatory approaches.

### *3. The Forest Policy, 1998*

The National Forest Policy's goal is to enhance the contribution of the forest sector to the conservation and sustainable management of Tanzania's natural resources for the benefit of present and future generations. The main policy objectives include: (i) enhancing sustainable supply of forest products and services,(ii) maintaining sufficient forest area under effective management, (iii) increasing employment and foreign exchange earnings through sustainable forest based industrial development and trade, (iv) guaranteeing ecosystem stability through conservation of forest biodiversity and water catchments, and (v) promoting the national capacity to manage and develop the forest sector in collaboration with other stakeholders.

#### *4. Food and Nutrition Policy for Tanzania, 1992*

The objective of the policy is to integrate food and nutrition activities undertaken by various sectors to improve the nutrition status of communities. It has been observed that the production of food crops is inadequate because of low land productivity, improper land use, lack of adequate and appropriate technologies and inputs, droughts, floods and other natural disasters. Among the measures proposed by the policy to improve and consolidate the production of various foods are: strengthening and supervising the implementation of rules and regulations pertaining to land conservation, encouraging irrigation farming and ensuring that adequate and appropriate implements and inputs are available and used. Farmers' education has to be strengthened and improved to facilitate sustained production of food crops.

#### **4.2.1.4. Kenya**

Kenya covers an area of 580,367 Km<sup>2</sup> and is located along the equator in eastern Africa. It is bordered by Ethiopia to the north, Somalia to the east, Sudan to the northwest, Tanzania to the south, and Uganda to the west. The country's population is estimated at 39 million, and has been growing at a rate of about 2.9 per cent per annum. Kenya is the regional hub for trade, finance, and the service industry in Eastern and Central Africa. By 2010, the country's GDP mainly came from the service industry, agriculture and manufacturing. Yet, despite Kenya being the best developed economy in Eastern Africa, about 50 per cent of the country's population falls below the poverty line.

Agriculture currently contributes 26 per cent of the GDP directly and another 25 per cent indirectly. The sector also accounts for 65 per cent of Kenya's total exports and more than 70 per cent of informal employment in the rural areas. The agricultural sector comprises six sub sectors namely: industrial crops, food crops, horticulture, livestock, fisheries and forestry. The sector employs such factors of production as land, water and farmers' institutions (cooperative societies, farmer associations). The rural economy of Kenya mainly depends on smallholder subsistence agriculture, which produces about 75% of the country's total agricultural output. With 51% of the population being food insecure, agriculture is critical to the country's economic development (IFAD, 2011a; Government of Kenya, 2010; CIA, 2010; Government of Kenya, 2004).

Despite the importance of agriculture for Kenya's development, its full potential has not been realised. The productivity of the sector has been challenged and constrained by insufficient transport and market infrastructure, low agricultural output and productivity, and poor performance of research and extension systems. Other constraints include: poor access to agricultural information and technologies, low access to credit by producers in

spite of a well-developed financial sector and weak institutional capacity (Government of Kenya, 2010). The high and increasing human population exerts pressure on fragile ecosystems, leading to desertification especially in arid and semi-arid regions and land degradation in the medium to high potential areas (Kaumbutho and Kienzle, 2007). Over the years, soil fertility in Kenya has drastically decreased (Wangungu et al., 2010) and small scale farmers face daunting challenges in their soil replenishment efforts (Sanchez et al., 1997). One of the major factors contributing to this decline is soil impoverishment caused by continuous cropping without adequate fertilizers and/or manure, mostly due to lack of readily available resources to replenish the soil (Murage et al., 2000).

Undoubtedly, substantial efforts have been made to replenish the fertility of degraded soils in attempts to raise crop yields and boost food security. The Kenyan government has initiated several soil fertility enhancement and conservation programs, sometimes in partnership with donors and research institutions. Agroforestry and Integrated Soil Fertility Management (ISFM) have been identified as some of the strategies that can sustain soil health (Buresh et al., 1997; Vanlauwe et al., 2002). CA has also been promoted as a suitable intervention to ameliorate the problem. In the long term, the role of agroforestry in adding fertility to CA farming systems is appreciated and some research in the region has shown the benefits of some agroforestry tree species within CA systems in increasing soil fertility (GART, 2008).

In Kenya, the concept of CA is still new and is mainly promoted at pilot level in project sites and communities. However, projects and organisations prefer to use similar sites, leading to duplication of techniques in particular districts with little spreading to neighbouring districts (Kaumbutho and Kienzle, 2007). Several organisations have been promoting conservation agriculture in smallholder farms in Kenya since 1997 though the activities became more prominent in the early 2000s. The organisations include the Kenya Agricultural Research Institute (KARI), the Regional Land Management Unit (RELMA), FAO, the Kenya Network for Dissemination of Agricultural Technologies (KENDAT), the International Livestock Research Institute (ILRI), the Semi-Arid Rural Development Programme (SARDEP), the World Agroforestry Centre (ICRAF), Tropical Soil Biology and Fertility (TSBF), the Kenya Forestry Research Institute (KEFRI) and the Kenya Rainwater Harvesting Association (KRA).

Through these projects, farmers have been trained on CA practices through farmer groups. Various implements and cover crops were also tested and promoted. In western Kenya, an umbrella body involving organizations such as ICRAF, KARI, TSBF, KEFRI and the Ministry of Agriculture (the Consortium for Scaling-up Options for Farm Productivity; COSOFAP), aimed to increase soil fertility and conservation agriculture through use of legume fallow crops



such as *Tephrosia* and *Crotalaria*, striga control, and disseminating best farming practices and skills to farmers. It organised field days and trade fairs for farmers in which supporters and policy makers were also brought in. Through research by KARI, the weed suppression capacity of many cover crops was established under different conditions, which included establishing the allelopathic effects of cover crops on weed species. Based on this work, KARI recommended the use of *Dolichos lablab*, *Mucuna* and *Canavallia* as suitable cover crops for Laikipia and Siaya districts, although *lablab* is more widely used because its seeds are edible. In addition, Kenya has embarked on a long term economic policy, the Vision 2030. The vision seeks to propel the country into a medium income nation and the Agriculture sector is anticipated to play a key role in achieving this vision. The following two strategic thrusts are relevant to achieving the vision and enhancing CA: transforming land use to ensure better utilisation of high and medium potential lands, and developing arid and semi-arid areas (which constitute 80% of the national land mass) for production of both crops and livestock. CA and agroforestry are some of the interventions that have been proposed towards achieving these goals.

Kenya has some policies that could support the scaling up of CAWT. These include:

1. *National Food and Nutrition Security Policy (NFNP)*

The Food and Nutrition Security Policy (FNSP) provides an overarching framework covering the multiple dimensions of food security and nutrition improvement. It has been purposefully developed to add value and create synergy to existing sectoral and other initiatives of government and partners. It recognises that hunger eradication and nutrition improvement are shared responsibilities of all Kenyans and calls for multi-public and private sector involvement. The policy and associated actions will remain dynamic to address contextual changes and changing conditions over time. The broad objectives of the FNSP are: to achieve good nutrition for the optimum health of all Kenyans, to increase the quantity and quality of food available, to increase accessibility and affordability of food to all Kenyans at all times, and to protect vulnerable populations using innovative and cost effective safety nets linked to long term development (Government of Kenya, 2010).

2. *National Forest Policy, 2005*

The goal of this policy is to enhance the contribution of the forest sector in the provision of economic, social and environmental goods and services. Specific objectives include: contributing to sustainable land use through soil, water and biodiversity conservation, enhancing the sustainable management of forests and trees, and encouraging the participation of the private sector, communities and other stakeholders in forest management to conserve water catchment areas. It also seeks to create employment, reduce poverty and ensure the sustainability of the forest sector. The Kenya Forest Service,

the institution created by the policy for forest administration, policy development, forest regulation, training, extension and protection of natural forests, works closely with the sectors of agriculture, water, land, energy and tourism. The Service works closely with the sectors of agriculture, water, land, energy and tourism. Within the new policy, funds to support forestry activities are obtained through revenue generated from improved management of plantation forests. The policy endeavours to domesticate as appropriate, international forestry related instruments and agreements. The Government also supports non state actors and local communities to undertake forest related development activities.

### *3. National Land Policy, 2007*

The overall objective of the National Land Policy is to secure rights over land and provide for sustainable growth, investment and poverty alleviation in line with the Government's overall development objectives. The land policy seeks to address the challenges of rapid urbanisation, inadequate land use planning, unsustainable production, poor environmental management, and inappropriate ecosystem protection and management. Specifically, the policy offers a framework of laws designed to ensure the maintenance of a land administration and management system that: (i) provides all citizens with the opportunity to access and beneficially occupy and use land, (ii) provides for economically, socially equitable and environmentally sustainable allocation and use of land, (iii) promotes the efficient, effective and economical operation of the land market, (iv) enhances effective utilisation of land and land based resources, (v) and guarantees transparent land dispute resolution mechanisms. Transforming land use for better and sustainable use and management will be achieved by creating a consolidated geographic information system (GIS) based land registry, developing and implementing a land use master plan, investing in institutions and infrastructure, and settling the landless poor.

### *4. National Irrigation and Drainage Policy*

This policy's overall goal is to accelerate sustainable development of irrigation and drainage to contribute to the national goals of wealth and employment creation, food security, and poverty eradication. The policy aims to: (i) accelerate development of the irrigation and drainage potential in the country (Gitau et al., 2009), (ii) achieve food security, (iii) create employment, (iv) promote, coordinate, manage and regulate the core activities within the irrigation and drainage sub sector, (v) mobilise and increase financial resources, (vi) create an appropriate financing system that will attract investment in the sector, (vii) increase government's financial allocation to the sub sector to at least 2 per cent of the GDP annually, (viii) create an enabling environment for effective farmer organisation and participation, and for other stakeholders to provide quality and cost effective support services, and (ix)

establish and promote a multi-sectoral approach to sustainable irrigation and development and management (Government of Kenya, 2010).

#### *5. Extension Policy, 2005*

This Policy gives guidelines on the coordination and regulation of extension services in Kenya, by revising the National Agricultural Extension Policy (NAEP) in order to give it a sector wide dimension and representation. The Policy covers all extension service provision with regards to crops and livestock (Gitau et al., 2009).

#### *6. The Agriculture Sector Development Strategy (ASDS)*

The Agricultural Sector Coordination Unit (ASCU) was established in 2005 to address the fragmentation of responsibilities between agriculture and rural development related ministries and non-state actors. ASCU was tasked with spearheading the implementation of the Strategy for Revitalising Agriculture (SRA), which was the sector strategy for addressing the Economic Recovery Strategy for Wealth and Employment Creation (ERS). Under the ASCU, the government prepared the Agriculture Sector Development Strategy (ASDS). The ASDS marks an ambitious approach of umbrella policy making by merging ten different sectors, thereby providing a more integrated policy framework with minimum duplication and increased efficiency (Government of Kenya, 2010). It is a strategy to position the agricultural sector as the key driver for delivering the 10 per cent annual economic growth rate envisaged under the economic pillar of Vision 2030.

The SRA provides the policy and institutional environment conducive for increasing agricultural productivity, promoting investment, and encouraging private sector involvement in agricultural enterprises to enhance poverty reduction. Its initiatives are in tandem with stated government policies and strategies such as the draft National Food and Nutrition Policy and many others that root for sustainability in agricultural production systems. Specifically, the ASDS's roles are: to drive reforms in the sector and fast track implementation of its objectives in a coordinated manner across sector ministries and other partners, to collect, analyse and disseminate information on agricultural reforms, to influence sector resource allocation to areas of highest impact, to initiate major studies and policy developments within the agricultural sector, to be a centre for capacity building for all stakeholders involved or affected by the agricultural reform process and to monitor implementation of ASDS activities. CAWT policies and implementation may fall under the ASDS.

## *7. National Environment Policy*

Kenya's environmental laws are scattered in a multiplicity of sector specific laws and policy papers. The ministry of environment and mineral resources is formulating a National Environment Policy to provide a holistic approach to the management of the environment and natural resources by mainstreaming environmental considerations into development planning and environmental management. The policy aims at attaining a 'green' economy by among others, promoting green investment, decreasing energy and resource use per unit of production, decreasing carbon dioxide and pollution levels per unit of GDP, decreasing wasteful consumption and by addressing emerging environmental challenges such as climate change. It also seeks to provide a clear policy direction for effective implementation of the Environmental Management and Coordination Act and the Constitution, to harmonise conflicting policies in key sectors such as water, forestry, wildlife, energy and agriculture with a view to enhancing cross- and inter sectoral linkages. The policy further provides a framework for wider participation in the management of the environment and natural resources, and to curb the marked increase in environmental degradation and loss of biodiversity (NEMA, 2012).

### **4.3 Conclusions**

Based on the findings from these studies, it is apparent that there are adequate policies both at regional and national levels that could advance the scaling of CAWT in Africa. At the continental level, the AU-CAADP initiative and the RECs offer sufficient impetus to support the scaling up of CAWT activities and to establish a regional platform that can serve as the mouth pieces for CAWT related activities (more on CAADP in Chapter 6). However, of concern is that CAWT in and by itself would be a very narrow mandate for such a platform and thus there would be need to hinge it within existing sustainable farming programmes. At individual country level, although there lacks a single comprehensive policy document on CAWT, policy statements and government strategies within sectors such as the environment, land, agriculture, forestry, and water support CAWT activities under the framework of broader conservation and sustainable resource management programs. The study also finds that a uniform policy prescription to favour specific countries and regions would not be realistic due to varying agro ecological, socio economic, physical and cultural factors. It is proposed herein that CAWT be integral to amendments to existing policies in order to mitigate problems facing land use and management, rather than deploying efforts at developing a stand-alone CAWT policy framework. Furthermore, there is need for more empirical studies to establish specific conditions under which CAWT supportive policies can

enhance scaling up. This would inform better targeting of activities intended to scale up CAWT in Africa.

## **5. INSTITUTIONAL FRAMEWORKS FOR SCALING UP OF CAWT TECHNOLOGIES: THE CASE OF KENYA, TANZANIA, ZAMBIA AND GHANA**

### **5.1 Introduction and methods**

The objective is to assess policy and institutional factors that influence scaling up of agroforestry based CA technologies and opportunities for policy reforms and institutional strengthening. MSc students are engaged in Kenya and Tanzania while FORIG scientists conducted the study in Ghana. Consultants were also hired to conduct a quick analysis in Tanzania and Zambia. The main sources of literature were relevant policy documents of governments, relevant journal papers, working papers, reports, books, and electronic media. Professionals in the agricultural and related fields were also consulted to shed light on subjects requiring further insight. Below we report the specific methods applied for the data collection and analysis and the findings for each country. From the data gathered from the institutions the project embarked on developing a live web portal which will show CAWT related R&D work that has been conducted in the countries to inform future initiatives. This was initiated for Kenya and Ghana for the reporting phase. A picture of the Kenya portal is shown as Figure 5.1.

### **5.2 Country Specific Analysis**

#### **5.2.1 Kenya**

The study in Kenya was carried out mainly through a desktop review of various institutions and their arrangement regarding promotion of CA and agroforestry. The review was coupled by a survey carried out in twelve institutions, which were evidently involved in CA, AF or both. Each institution had its own unique projects and intervention strategies according to its mandated area of operation, vision, mission, project objectives and targets. These institutions included Universities with Agriculture in their curriculum (Egerton, KU, KEMU, UoN- Kabete Campus, JKUAT), KARI, KENDAT, CETRAD, CARE – Kenya, SACRED, KEFRI, World Vision Kenya (WVK), Sustainable Agriculture Community Development Program (SACDEP), C-MAD, CIMMYT, Ministry of Agriculture's ATDCs, and FEMOWORKS (a local CA implement fabrication company) among others. Questionnaires were sent to contact individuals in the institutions that were already aware of the process. For the other identified institutions, an introductory letter was sent to their general address first, and afterwards, specific individuals were appointed to provide the information needed by filling out the questionnaire, and send them back. Follow up was done through emails and telephone calls

followed by corresponding acknowledgement for those who filled and returned the questionnaires.

### Description of the focal study Area

At the local level, the survey was carried in two divisions in Meru Central District in Meru County and two divisions in Kibwezi District in Makueni county. These sites were selected as they represented contrasting sites with different agro-ecological zones hence an attempt to capture local views representative of the country in semi- arid and humid areas. A total of 120 farmers constituted the sample size in both Districts. Twenty six key informants including Government officers and Non-Governmental Organization (NGO) officers at the national level were also purposively sampled during the study.

**Table 5.1: Some key characteristics of the study sites in Kenya where farmers were interviewed**

Descriptions	Kibwezi	Meru
Coordinates	Latitude 2° 24'S and Longitude 37°59'E	Latitudes 0° 22' South and 0°19' North, and between Longitudes 37° 5' and 37° 55' East
Agro-Ecological Zones	Lower Midland (LM ) Lower Highland (LH ) and Inner Lowland (IL)	Upper Highland (UH), Upper Midland (UM) and Lower Midland (LM)
Annual Mean Temperature	22.6°C	17.8°C
Annual Mean Rainfall	The rainfall is bimodal, ranging from 600 to 900 mm, with long rains season starting from March to July and short rains season from October to December.	The rainfall is bimodal, ranging from 400 to 2200 mm, with long rains from March to June and short rains from October to December.
Soils	The soils are predominantly Luvisols and Ferrasols	The soils are mainly Humic Nitisols

### Institutional Frameworks opportunities for supporting CAWT in Kenya

The Kenyan Agriculture sector is regulated by policies developed by the government, led by the Ministry of Agriculture. Since independence, Kenya has seen evolution of agriculture policies from the periods when there was a lot of government control in agriculture to the phase where liberalization has reduced government intervention. The policy reforms in Kenya have revolved around a number of issues including institutional frameworks.

Currently, the agricultural sector in Kenya is governed by 131 pieces of legislation including legislation for supporting institutions. It's also affected by a myriad of by-laws made and implemented by the local authorities, and specific laws governing commodities that set out costly and separate institutional and management arrangements.

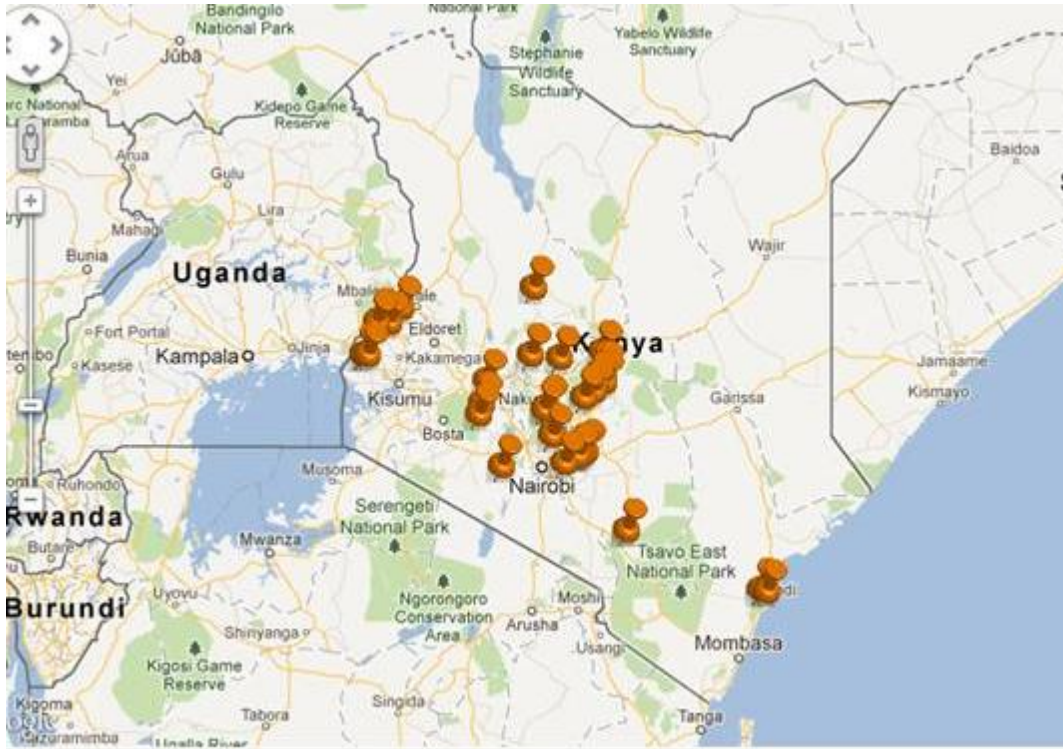
The current institutional environment in Kenya provides ample scope for integrating the CAWT principles in its NRM policies and strategies. The government formulated the environmental framework law, referred to as the Environmental Management and Coordination Act (EMCA) No. 8 of 1999. EMCA provides for the "establishment of an appropriate legal and institutional framework for the management of the environment and for matters connected therewith and incidental thereto". The Institutional structures created and legal instruments applied for through EMCA were meant to be synergistic and interconnected with other regime structures. The legal property regime governing land use in Kenya is the informal law or customary law, which is based on the socio-cultural values and institutions of local communities utilizing the land resources (Odhiambo and Nyangito, 2002).

During the Second Kenya National Seminar on Agroforestry, held in Nairobi, in 1988, it was found that institutional issues were the main constraint limiting the full realization of the potential of agroforestry to increase the productivity, sustainability, and economic diversity of rural lands in Kenya (Kilewe et al., 1988). The participants noted that agroforestry development in Kenya has suffered because of a lack of institutional coordination in field extension. There has also been concern about an institutional base for agroforestry extension. It was at almost the same time where some efforts to formalize institutional cooperation on various aspects of agroforestry were identified, these include (i) setting up of a National Steering Committee on Agroforestry Research under the National Council for Science and Technology (NCST) with all main governmental and NGO "actors" being members. (ii) drafting a Memorandum of Understanding for ministerial cooperation and coordination of agroforestry efforts in Kenya, (iii) develop six agroforestry centres to be valuable extension tools for both the Ministry of Agriculture and the Ministry of Environment and Natural Resources (RAES) as well as being main suppliers of multipurpose tree seeds for a variety of government and NGO projects in the country; (iv) setting up a National Tree Seed Committee to coordinate issues related to quality control and dissemination of tree seeds throughout Kenya (Kilewe et al., 1988).

Many organizations and institutions have been involved in conservation agriculture. These are the Food and Agriculture Organization of the United Nations (FAO), the World Agroforestry Centre (ICRAF), the Kenya Agricultural Research Institute (KARI), the Technical



Cooperation Programme Farming in Tsetse Controlled Areas (FITCA), the International Centre for Insect Physiology and Ecology (ICIPE) and the Consortium for Scaling-Up Options for Farm Productivity. FAO had two projects, the Technical Cooperation Programme and Conservation Agriculture and Sustainable Agriculture and Rural Development, which promoted the three principles of conservation agriculture. ICRAF promoted improved fallows in agroforestry. FITCA promoted draught animals in farming and collaborated with the Kenya Network for draught Animal Technology (KENDAT; now Kenya Network for Dissemination of Agricultural Technologies) and Triple W Engineering on draught animal technology. Farming in Tsetse controlled Areas introduced legume cover crops such as mucuna and canavalia. They collaborated with Monsanto and Bayer East Africa to promote weed control using herbicides. ICIPE and KARI were involved in controlling striga weed and stem borer and improving soil fertility using push-pull technology. This proves that there have been some efforts to set up institutional frameworks that support conservation agriculture and agroforestry and thus conservation agriculture with trees in Kenya



**Figure 5.1: A map showing areas in Kenya where various institutions are working as entered in the web-portal**

### **Institutional Frameworks Governing CAWT at the National Level**

The Agriculture Act (Chapter 318) established the Agricultural Boards as a means of implementation of the policy, comprising the Central Agriculture Board, Provincial Agricultural Board, the District Agricultural Committee and the Sub District Agricultural Committee at the national, provincial, district and divisional levels, respectively. According to Odhiambo and Nyangito (2002), these boards, which have an advisory and statutory role to the Minister for agriculture, act as second tier enforcement institutions after arbitration or control by the executive have failed. However, Arwings-Kodhek (2005) argues that the National, Provincial and District Agricultural Boards are non-existent and no longer needed and should preferably be replaced by an umbrella body. Kenya's post-colonial Government employed a vertical planning approach in which local communities were treated as passive recipients rather than active players in natural resource management. Hence, despite efforts of the Kenyan Government to adopt bottom-up approaches, many critical decisions remain a preserve of the Central Government (Yatich *et al.*, 2007).

Both formal and informal institutions play a key role in the existing policy reforms. The key institutional players within Kenya's Natural Resource Management regime are the national

government agencies, local governments, Non-Governmental Organizations (NGOs) and participating Community Based Organizations (CBOs) (Yatich *et al.*, 2007).

Most of the national government agencies have been established by an Act of Parliament. The Agriculture Act mandates establishment of Authorities in cases where a particular crop should be promoted or fostered. This has led to several organizations established to support different agricultural activities although various circumstances have resulted in collapse of many of these organizations and the Government has had to intervene in some cases to revive them. There have been 18 Agricultural and Marketing Organizations established including the National Cereals and Produce Board, Tea Board of Kenya, The Kenya Maize and Produce Board, the Agricultural Finance Corporation, among others.

There are various NGOs that promote approaches enhancing natural resource management. Yatich *et al.* (2007), noted that the Kenyan government has created an enabling environment for the growth and development of a vibrant NGO sector. An example of these NGOs with a CA focused approach is the Kenya Network for Dissemination of Agricultural Technologies (KENDAT) which was a key member of the Kenya Conservation Tillage Initiative. Between 2004 and 2006, KENDAT ran its own CA project titled “Advancing conservation agriculture through farmer knowledge, experience sharing and artisanal support” with support from other collaborators. An innovative approach of Village Information Resource and Exchange Centres (VIRECs) aims at organizing small scale farmers for trainings, and in the last 15 years, KENDAT has exposed small scale farmers in conservation farming practices, focusing on soil, water and farm power efficiency in journeys from subsistence to commercial farming (<http://www.kendat.org/core-departments/village-information-resource-and-exchange-centres-virecs>).

### **Institutional Frameworks Governing CAWT at the Small Scale Farmer Level**

During this study it was important to understand the awareness of the small scale farmers on institutions that have a CA approach at the local level. It was found that CA was not a common practice in Kibwezi, but agroforestry practices had been widely popularized in the area. In Meru, agroforestry was widely practiced in the wetter areas of Abothoguchi and Katheri Divisions while CA was practiced in the drier Buuri Division. This finding suggested that CA was not uniformly practiced in all regions and it agrees with the finding by Ajayi *et al.* (2007), that who observed a spatial dimension to the adoption of soil replenishment technologies in Southern Africa and that technologies did not perform equally well in all locations. The emphasis should therefore be to establish proper targeting to ensure that the technologies create the desired impact among small scale farmers.

The analysis of institutions that promote CAWT agenda revealed that respondents in Kibwezi identified research institutions (38.3%), government ministries (33.3%) and NGOs (30%) as institutions that had an agroforestry approach. The active research institutions in the area included Kenya Forestry Research Institute (KEFRI) and Kenya Agricultural Research Institute (KARI) while the widely known Government Ministry promoting agroforestry in the area was the Ministry of Agriculture (MoA). The NGOs actively involved in agroforestry issues in the area were German Action Aid (GAA) that promoted preservation of water catchment areas by encouraging tree planting and constructing water storage facilities for the people. The Red Cross Society and the World Vision were also some of the other NGOs actively involved in promoting agroforestry in Kibwezi area. In Meru, NGOs (18.3%), and Government ministries (13.3%) were considered as formal institutions with a CA focus (Table 2). Meru Drylands Project and the International Small Group and Tree Planting Program (TIST) were the most active NGOs, especially in Buuri Division. The MoA, was actively engaged in promotion of agroforestry systems in Meru.

**Table 5.2: Awareness on Existing Formal Organizations Promoting CA**

Formal Organization	Kibwezi Awareness		Meru awareness	
	N	%	N	%
Private companies	9	15	2	3.3
Research organizations	23	38.3	3	5
Government ministries	20	33.3	8	13.3
Church organizations	9	15	1	1.7
NGOs	18	30	11	18.3
Volunteer groups	3	5	2	3.3

As to regards Community Based Organizations (CBOs), farmer groups (21.7%) and church groups (6.7%) were considered more active in promoting agroforestry in Kibwezi. The farmer groups active in Kibwezi were Self Help Groups (SHGs) such as Muungano Nguvu Yetu SHG, Kanini Kaseu Mtito Andei SHG, Nzambani Fruit Growers, Makutano adaptation to climate change group, Matengelu SHG, Ufunguo Group, among others. The Latter Day Saints Church had also engaged with the local communities extensively in agroforestry-related activities. In Meru, farmer groups (18.3%) and women groups (13.3%) were perceived to have a CA focus (Table 3).

**Table 5.3: Awareness on Existing CBOs Promoting CA**

Community Based Organizations (CBOs)	Kibwezi Awareness		Meru awareness	
	N	%	N	%
Farmer groups	13	21.7	11	18.3
Women groups	3	5	8	13.3
Church groups	4	6.7	0	0

CBOs were especially active in Buuri Division. Farmer groups active were CA groups such as Munanda CA group, Riiji Kamuketha CA Group and Mukungu CA group. Muchui Women group was actively engaged in tree planting in the community.

### 5.2.2 Tanzania

This study approach was mainly participatory policy analysis, both national and local level, utilizing the following methodological framework:

- i. Having interviews with government officials and NGOs key informants at national level with an emphasis on identifying incentives and disincentives for CAWT adoption.
- ii. Desk reviewing the identified major policy documents
- iii. Policy-response framing at the local level with small scale farmers with a focus on propositions to increase policy incentives and reduce policy gaps.

Field visits were made to five districts which are Meru, Arusha, Karatu, Babati and Kongwa and discussions were held with both administrators and technicians. Various institutions and Non-Governmental Organization (NGOs) were also visited where consultations and discussions were made with researchers, technicians and administrators. These included the Sokoine University of Agriculture (SUA), the Centre for Agricultural Mechanization and Rural Technology (CAMARTEC), Selian Agricultural Research Centre (SARI), The Institute of Resource Assessment (IRA) of the University of Dar es Salaam, ICRAF and Research, Community and Organizational Development Associates (RECODA). Government Ministries that were visited included Ministry of Agriculture Food security and Cooperatives, Ministry of Industry and Trade, Prime Minister's Office, Ministry of Natural Resources and Tourism and the Vice President's Office (VPO) where consultations and discussions were held with respective Directors and senior officials. A check list was prepared and circulated to various institutions to gather more information on conservation agriculture and agroforestry. This was followed by a detailed desk study of relevant literature on CA and CAWT.

At the local level, the survey was carried out in Karatu and Mwanga Districts. These sites were selected as they represent contrasting sites with different agro-ecological zones hence an attempt to capture local views representation of the country in semi- arid and humid areas.

Karatu is one of five districts in Arusha Region, located in the northern part of Tanzania. It is located south of the equator between latitudes 3°10'–4°00'S and longitude 34°47'E. The district covers 3300 km<sup>2</sup>. Land use is classified as follows: arable land 102,573ha; pastureland 155,808 ha; forest, bush and tree cover 61,218 ha; and Lake Eyasi 1060 ha. Karatu District borders Mbulu District to the west, Ngorongoro District to the north, Babati Rainfall in the district is bimodal with amounts ranging from less than 400 mm in the Eyasi Basin to over 1000 mm in the highlands. Mwanga District is one of the six districts of Kilimanjaro Region. The district covers an area of 2,641 km<sup>2</sup> and lies between the latitude 3°46' to 3°47' South and longitude 37°35' to 37°50' East. It is bordered by Same district in the South, Simanjiro District in the West, Moshi Rural District to the North, and Kenya and Lake Jipe in the Northeast. The district mainly comprise of the Eastern and Western Lowlands (700-1000 m asl) and the North Pare Highlands (1300-2200 m asl). The Eastern and Western Lowlands occupy 600 km<sup>2</sup> (22.72%) and 1,233 km<sup>2</sup> (48,21%) respectively. The lowland areas include the water bodies of Lake Jipe and Nyumba ya Mungu Dam. The highland occupies only 808 km<sup>2</sup> (29.7%). The climate in Mwanga District is generally semi-arid with rainfall amounts ranging from 500-1000 mm/year.

The research design was cross sectional collecting data from the single point at a time. A purposive sampling procedure was used to obtain government officials, key informants and household land use primary data collection. Purposive sampling was used to get the 30 government officials and the NGOs key informants from the relevant sectors that were conversant on conservation agriculture. Random sampling was adopted at local level where the village register gave the sampling frame and 100 farm households were sampled, 50 from each district. The quantitative data collected during the field survey were at first coded and analyzed statistically using SPSS. Means and frequencies were calculated for some variables and presented in the form of tables and charts.

### **Institutional Frameworks opportunities for supporting CAWT in Tanzania**

A wide spectrum of actors is involved in the implementation of agricultural activities some of which have some bearing on conservation agriculture with trees. The various actors in the sector include public, private and civil society institutions.

The Agricultural Sector Lead Ministries (ASLMs) consists of the Ministry of Agriculture Food Security and Cooperatives (MAFC), Ministry of Livestock and Fisheries Development (MLFD), Ministry of Industries, Trade and Marketing (MITM) and Prime Ministers' Office Regional Administration and Local Government (PMO-RALG). Currently, these ministries are responsible for implementing the ASDS and ASDP, which is the main tool of central government for coordinating and monitoring agricultural development, and incorporating national wide reforms. PMO-RALG is responsible for coordinating the implementation at the district level, while MAFC oversees the implementation at national level.

Among these, there are a few public and private sector institutions that are implementing some activities that have some elements of conservation agriculture with trees. These include ministries (MAFC, MLFD, VPO, MNRT and PMO-RALG), public institutions, NGOs and Farmer organizations. Generally such efforts especially across Ministries and various players are isolated and lack a coordinating mechanism. Within the MAFC the Departments of Research and Development, Agricultural Mechanization, Crop Development, Land Use Planning and Training together with EMU are more involved in these activities.

#### **MAFC Five Year Environmental Action Plan 2012-2017**

MAFC has an Environmental Management Unit (EMU) whose functions include monitoring compliance with the requirements of the Environmental Management Act (EMA) within the Ministry. MAFC completed the development of its Five Year Environmental Action Plan in September 2011. The plan will be implemented under the Ministry's Environment Unit. Among the key issues that have been identified include land degradation, pollution by agrochemicals, lack of land use plans in some districts, inadequate human and financial resources, adverse effects of climate change, introduction of GMOs, unplanned peri-urban agriculture and inadequate awareness on environmental issues.

Some of the activities proposed in addressing these constraints include preparation and dissemination of guidelines on various technologies regarding proper land use practices, development and design of adaptive and mitigation measures in agriculture and to undertaking training and demonstrations on new technologies including the use of conservation agriculture implements. Some of the intervention activities may therefore include conservation agriculture with trees as it is a proven technology in sustainable land management and mitigation of climate change effects.

#### **Agricultural Sector Development Programme**

The ASDP is the leading instrument for financing and monitoring public sector support for reinvigorating Tanzania agriculture. The role of ASDP is to bring together, in a coherent

sequence, prioritized sub-programmes and to guide central Government investment to support field level activities in the agricultural sector. The implementation of ASDP is at the district level through the District Agricultural Development Plans (DADPs) and at national level where it is guided by the Agricultural Sector Lead Ministries (ASLMs) with 75% of financial resources going directly to the districts.

The ASDP identifies the need to streamline crosscutting issues and has provided for institutional framework on environmental management issues. The ASDP underscores the importance of promoting environmental research through linkage with the Vice President's Office and NEMC. At the district level farmers are encouraged and facilitated to come up with development projects that are consolidated into District Agricultural Development Plans that are financed directly by the programme. ASDP therefore has potential to support the up-scaling of conservation agriculture with trees in the country through awareness creation to enable farmers to come up with issues for intervention on conservation agriculture/with trees. There are already a number of projects which have been financed through DADPs.

#### **The Vice President's Office**

The Vice President's Office (VPO) is responsible for overseeing government's response to environmental issues. It is also responsible for coordinating NGOs' activities some of which are active in the development of the agricultural sector. The VPO is undertaking some activities on environmental issues including focus on climate change as part in the implementation of the Tanzania National Adaptation Programme of Action (NAPA) which was prepared in 2007. Among the activities that are undertaken include: improving food security in drought-prone areas by promoting drought tolerant crops in Shinyanga, Dodoma and Singida regions; improving water availability to drought stricken communities in Dodoma and Singida regions and climate change adaptation through participatory reforestation on Kilimanjaro Mountain. Collaborative activities on conservation agriculture with trees may be looked at as they address environmental issues including climate change mitigation.

#### **Ministry of Natural Resources and Tourism (MNRT)**

The Ministry for Natural Resources and Tourism, supports sustainable management of forest resources especially through Participatory Forest Management (PFM) involving communities and farmers. The ministry is also responsible for catchment's management, beekeeping, biodiversity, germplasm conservation and wildlife management. The MNRT through its



Department of Forestry and Beekeeping is implementing some activities in afforestation where collaborative activities on conservation agriculture with trees may be initiated.

### **National Agroforestry Steering Committee (NASCO)**

The NASCO was established in 1993 to coordinate Agroforestry Research and Development in Tanzania and the Tanzania Forestry Research Institute (TAFORI) was appointed as the secretariat. The responsibilities of NASCO include: to oversee strategy implementation and undertake agroforestry policy development; to review and approve research, development and implementation proposals emanating from public and private sector partners; solicit funds from internal and external sources; co-ordinate national agroforestry programmes and projects; link with district level agroforestry committees; monitor and evaluate the Agroforestry strategy; provide annual performance reports on agroforestry strategy implementation to government, donors and the public at large; network with regional and international organizations; and undertake any other agroforestry issues of national interest. Therefore NASCO is a good link in supporting conservation agriculture with trees especially in the research agenda and policy issues.

### **CAWT National Task Force**

The CAWT National Task Force has recently been formed (as an output of this project) and comprises of members from the Ministry of Agriculture Food Security and Cooperatives (MAFC), Ministry of Natural Resources and Tourism (MNRT), Vice Presidents' Office - VPO, University of Dar es Salaam - Institute of Resource Assessment, Sokoine University of Agriculture, Intermech Engineering Ltd, World Vision Tanzania, African Conservation Tillage Network (Tanzania) and World and Agroforestry Centre (ICRAF). This organization if well supported may be appropriate to spearhead the up scaling of conservation agriculture with trees in the country.

### **Institutional Frameworks Governing CAWT at the Small Scale Farmer Level**

The study managed to identify quite a number of institutions that influence the adoption of CAWT. These institutions range from the existing policies (agriculture policy, land policy, livestock policy and forestry policy) government research agency (Selian Agriculture Research Institute), Seed Agencies and Agro-Input companies and some NGOs. The table below shows the organizations observed during the study and the role they play in promoting the adoption of CAWT.

**Table 1.4: Institutions and their role in promoting CAWT in Karatu and Mwanga**

Institution	The role played in Conservation agriculture	Status
SARI(Research Institute)	Conduct Training on the CAWT	+++
	Manage demo plots	
	Conduct research on Seed and CAWT Tools	
CIPAR(NGO)	Support SSFs through FFS trainings	+++
	Organize the SSFs groups and monitor CAWT	
	Manage Demo plots in Karatu villages	
MIFIPRO(NGO)	Promote Irrigation agriculture	+
	Promote Agroforestry Activities in Mwanga district	
Karatu District Office (DALDO)	Coordinate tree planting programmes	+
	Promote organic farming	
	Provide extension services at ward and villages	
Karatu Development Association (KDA)	Support micro-finance project through trainings	--
	Held demo plots on varieties of crops e.g lab lab	
	Promote sustainable energy activities	
Tanzania Farmers Service Centre (TFSC)	Had demonstration plot with cover crops	---
	Sells agricultural machinery and spare parts	
Tanganyika Farmers Association(TFA)	Main supplier of inputs e.g. seeds, pesticides and fertilizers	++
	Promotes use of improved varieties e.g lab lab	
Village(s) office	Promote the formation of bylaws	+
	Implement the formed bylaws	
	Translate the government policies to farmers	
Ministry of Agriculture, Food Security and Cooperatives (MAFSC)	Make policies	+
	Promote the research on CAWT	
	Ensure political audience	

**Key;** (+ or -) indicates positively or negatively engaged in promoting CAWT currently

### **Institutional Frameworks**

Wide spectrums of actors responsible for implementation of CA were found in place. These actors include the Ministry of Agriculture Food Security and Cooperatives through different departments (Department of Agro-Mechanization, Seed department etc), The government through the prime minister's office linking to the local government authorities which govern the execution of laws and by-laws at the village level, different public research agencies for example SARI(Selian Agriculture Research Institute) which are the leading pioneers of CAWT in Karatu and now introducing it in Mwanga districts. The module of operation is still Top-

Down Approach whereas the policies/technologies are made at the institution's level and enforced at the village level. The institutions that are set up to promote and support CAWT need to be dynamic since CAWT is not static so that they can respond to farmers' varied and changing needs.

R&D activities are planned to ensure that good husbandry of crops, land and livestock can occur simultaneously for the system to function well. Both the technical and social sciences need to be combined with the views and opinions of stakeholders to develop technologies and systems that can be adapted to varied conditions facing farm families adopting CAWT as a way of farming. This means that the diverse providers of information – and their investors – need to be involved in broad programmes to develop the science and technology for CA. Such institutions include international agencies, multi-donor programmes, NGOs, national government staff, academic institutions, commercial organizations and agribusiness. Each brings a different expertise and understanding to the table. However, unless these are tied together within a common framework of understanding of the principles and benefits of CAWT, their potential synergy cannot be felt. One way forward would be to develop common indicator sets to assess progress towards the environmental, economic and social benefits of CA. This would help promote CA as the sustainable alternative to tillage-based agriculture techniques, and to build a common basis for understanding the potential of CA for both large and small-scale farming communities.

### **5.2.3 Zambia**

The study in Zambia employed various methods of obtaining data and information including office visits, consultations and discussions to solicit relevant documentation followed by a desk study of relevant literature. The starting point was the identification of key and relevant policy focal points that generally fell into one broad category of Government Ministries and Departments. The preliminary report was presented to the National Conservation Agriculture Task Force for review before circulation to the wider audience as part of the baseline survey activities.

#### ***Institutional Frameworks Governing CAWT in Zambia***

##### **The Ministry of Agriculture & Livestock**

The mandate of the Ministry of Agriculture & Livestock (MAL) is to:

- Attain and sustain household food self-sufficiency and to improve the nutritional status of the population;
- Expand and diversify agricultural production and exports;

- Increase farm incomes;
- Conserve the natural resource base;
- Formulate agricultural policies, legislation and regulations with stakeholder participation;
- Generate and disseminate agricultural information and technologies;
- Regulate and ensure quality control of agricultural produce and services; and
- Monitor and manage the food security situation.

To fulfill this mandate and perform the necessary activities, the Ministry of Agriculture & Livestock (MAL) is organised into 10 departments, which report directly to the Permanent Secretary for Agriculture & Livestock. The departments are: Human Resources; Department of Agriculture; Department of Animal Health; The Department of Livestock Development; The Department of Fisheries, The Department of Marketing; Department of Cooperatives and The Policy and Planning Department, Zambia Agriculture Research Institute (ZARI) and The Seed Certification and Control Unit (SCCI).

The Ministry has been further divided, administratively and technically, into 10 Provincial Agricultural Offices, headed by Programme Agriculture Coordinators (PACOs). Each PACO has specialists representing crop production, animal health and veterinary services, agricultural extension support services, research and technical services. The Provincial Agriculture Offices are subdivided into district offices, replicating the professional structure of the PACO. These are further sub divided into Agriculture Extension Blocks, which were further divided into Agriculture Camps. Under the Decentralisation Programme, the Ministry links to the Area Development Committees as the lower level local government planning structures coordinating development.

The Zambia Agriculture Research Institute (ZARI) has the responsibility of developing agricultural technologies for use by farmers in Zambia. ZARI is at the national level and operates three regional Research stations located in the main geographical regions: Mt Makulu in the Centre, Mochipapa in the South, and Kasama in the North. In addition to these regional stations, there are four Experiment stations spread over the different regions: Muskera in Chipata, Mansa, Solwezi and Namushakendi in Mongu. There are also smaller sub-stations in each region where research activities take place on a more limited scale for a specific commodity and within a specific agro-ecological zone.

The Ministry headquarters, in principle, concentrates on functions of policy formulation and regulation, coordination of training, and collaboration with other stakeholders. The key stakeholders in relation to the Ministry are: other government ministries and departments, public sector institutions, NGOs, donors, small and large-scale farmers, farmers' associations,

input suppliers, agro-processors, international agriculture research centres, and produce buyers.

The role of the PACO's within the present hierarchical structure is to interpret and implement policies formulated at the central level, coordinate technical specialists, supervise programmes, and develop "technical messages" and further training of technical specialists and extensionists. At the District level, the functions of the District Agricultural Coordinator's Office (DACOs), now include dissemination of messages, training of Block and Camp Extension staff and farmers, providing technical advice and supervision of extension staff. At camp level, activities involve imparting technical messages to farmers, formation of farmer groups, conducting farmer demonstrations, and linking farmers to credit institutions.

The training of professional for the agricultural sector is carried out at the University of Zambia. A considerable number of Masters and PhDs have also been completed locally and abroad, while the training of technical staff who have the primary responsibility as frontline staff is done at the Natural Resources Development College (NRDC) and the Zambia Colleges of Agriculture (ZCA) at Monze and Mpika.

**Table 5.5: Summary of CA/CAWT stakeholders in Zambia**

Actor	Organizational mandate	Conservation agriculture		
		Roles	Responsibilities	Target areas
Technical Services Branch (TSB), Ministry of Agriculture and Livestock (MAL)	Planning, coordination, implementation, monitoring and evaluation of land resources conservation policy, legislation, programs and projects in the country	Secretariat of the National Conservation Agriculture Task Force	Farmer training, outreach, implementation of CAWT	Nation-wide
Zambia Agricultural Research Institute	Planning, coordination, implementation, monitoring and evaluation of agricultural research programs and projects in the country	Member, National Conservation Agriculture Task Force	Agricultural Research and Development Programmes	Nation - wide
Conservation Farming Unit	to increase production and income levels of small scale	Member, National	Farmer training,	Localized: 10

Actor	Organizational mandate	Conservation agriculture		
		Roles	Responsibilities	Target areas
(CFU)	farmers through improved agricultural practices with sustained conservation and management of the natural resources base	Conservation Agriculture Task Force	outreach, research	Districts
Zambia National Peasant and Small Scale Farmers Association (ZNPSFA)	an umbrella association of all farmer associations	Member, National Conservation Agriculture Task Force	Farmer training, outreach, CA demonstrations and Brokerage	Nation-wide
University of Zambia,	Teaching undergraduate and postgraduate programmes, research and outreach	Member, National Conservation Agriculture Task Force	Training, research, outreach	Localised
Natural Resources Development College (NRDC),	Teaching Diploma graduates and outreach	-	Training, research, outreach	Localised
Zambia National Farmers' Union	an umbrella body of all farmer organizations, cooperatives, associations	National Conservation Agriculture Task Force	Brokerage	Nation-wide
Care International	Facilitates aid to partner organizations	-	Farmer training, outreach	Localised
World Vision Zambia	Implementation	-	Farmer training, outreach	Localised

### **The National Conservation Agriculture Task Force**

The National Conservation Agriculture Task Force (NCATF) has been in existence for past 6 years. Its mandate is to promote the uptake of conservation agriculture in the country. In line with the regional efforts to establish CA task forces in each country to promote conservation agriculture in southern Africa, the National Conservation Agriculture Task Force (NCATF) in Zambia was launched in 2007.

The task force aims to advocate and influence agriculture policies and other policies related to conservation agriculture, facilitate capacity building amongst stakeholders and develop strategies for the roll out and adoption of conservation agriculture. Specifically the NCATF is expected to undertake the following activities;

- i. Facilitate networking of conservation agriculture implementers,
- ii. advocate and influence agriculture and other policies related to conservation agriculture,
- iii. Facilitate the development, packaging and dissemination of conservation agriculture through stakeholder consultation,
- iv. Facilitate capacity building among stakeholders,
- v. Participate in regional and global conservation agriculture related fora,
- vi. Monitor and evaluate conservation agriculture activities in the country and,
- vii. Solicit funding to support expansion of conservation agriculture activities in Zambia.

Although resource limitation remains a challenge to NCATF since its inception, the task force has managed to implement a number of activities such as field visits and review meetings in order to iron out some issues affecting the scaling out of conservation agriculture in the country.

The Ministry of Agriculture and Livestock currently holds the Chairmanship of NCATF and the Department of Agriculture is the Secretariat. NCATF is made up of voluntary members on invitation by the NCATF Secretariat.

Lack of capacity, weak institutions, a weak civil society, and repeated donor bail-outs have caused even the best policies and programs to be ignored, subverted or delayed to the point of being ineffective. Presently, CA/CAWT is enjoying coordinated collaboration between development partners, local NGOs, training and research institutions and other agencies under the guise of the National Task Force on Conservation Agriculture. This strategy needs to be further developed and reinforced to inform legislation and policy development for CA/CAWT. It is further suggested that NTFCA should focus on supporting mechanisms that

recognize effective decentralization (District Agriculture Offices) as an essential component to inculcate CAWT in rural agriculture.

In order to influence more buy-in for CA/CAWT from decision makers/ policy makers, it is proposed that NTFCA be strengthened to act as a Technical Committee (to appraise CA/CAWT activities) for a higher decision makers/ policy makers at the Ministerial level.

### **5.2.3 Ghana**

The study in Ghana was carried out mainly through a desk study research. Extensive literature search was conducted and data was collected by reviewing scientific and professional literature on conservation agriculture and conservation agriculture with trees, relevant policy and legal documents and consulting some professionals in the agricultural and related fields. Other literature, mostly of the grey type, that were reviewed included relevant project documents, project completion and evaluation reports, project newsletters, and project technical reports. This was supplemented with details obtained through a questionnaire sent to contact individuals in several pertinent institutions as had been done in Kenya.

#### **Institutional Frameworks opportunities for supporting CAWT in Ghana**

The mandate for land and soil conservation including CAWT lies mainly with the Ministry of Food and Agriculture (MOFA), which is the lead agency and focal point of the Government of Ghana, responsible for developing and executing policies and strategies for the agriculture sector within the context of a coordinated national socio-economic growth and development agenda. There are other ministries and government agencies that contribute to the development of the agricultural sector through cross-cutting and multi-sectoral policies and activities whose activities could promote/involve CAWT. For example, the Ministry of Lands and Natural Resources is responsible for the sustainable management and utilization of the nation's lands, forests, wildlife and efficient management of mineral resources for the country's socio-economic growth and development. Several other institutions are involved in the agricultural sector whose structure and function could directly be used for the implementation of CAWT. These include: various CSIR-Institutes, the Forestry Commission, Cocoa Research Institute of Ghana, the International Institute of Tropical Agriculture, NGOs, and other farmer based organizations.

Concerning institutional support for conservation agriculture in Ghana, the National Conservation Agriculture Team was formed consisting of representatives from MOFA (Crop Services Directorate, Agricultural Engineering Services Directorate, and Directorate of Agricultural Extension Services); research (Crop Research Institute, Savannah Agricultural



Research Institute, and Soil Research Institute); universities (Agricultural Engineering Department of Kwame Nkrumah University of Science and Technology, University of Development Studies); international organizations (the World Bank, the Food and Agriculture Organization of the United Nations (FAO), German Development Cooperation (GTZ)); and other projects and companies (Food Crop Development Project, Monsanto, Research Extension Linkage Committee) but has remained dormant for the past few years. The team was charged with coordinating conservation agriculture programmes in Ghana and with facilitating collaboration and building synergy among conservation agriculture practitioners. Individual projects provided funds for their representatives to attend meetings (Boahen et al., 2007).

In late 2003, with support from the Sedentary Farming Systems Project of GTZ, the National Conservation Agriculture Team facilitated preparation of a proposal aimed at piloting successful conservation agriculture practices that have been locally adapted in other parts of the country and for possible scaling up based on results. The Technical Cooperation Project proposal was submitted to FAO in early 2004 for funding but the whole proposal stalled for lack of funding (Boahen et al., 2007).

Various actors and stakeholders are involved in the implementation of agricultural activities some of which have some bearing to conservation agriculture with trees. The various actors in the sector include public, private and civil society institutions. However, it was noted that there is low level of awareness of CAWT practices and poor coordination of such practices/activities in the country. There is also very little or no coordination among all the various actors and stakeholders that develop and promote CAWT technologies in the country. In many instances, CAWT activities are carried out in isolation by various actors and institutions.

About half (53%) of the organizations, their scope of operation had some aspects of conservation agriculture, 60% agroforestry, and 33% CAWT (Table 5.6).

**Table 5.6: Institutions scope of operation**

<b>Name of Institution</b>	<b>CA</b>	<b>AF</b>	<b>CAWT</b>
Tropenbos International Ghana		?	
Ministry of Food and Agriculture (MOFA)		?	
Farm Front Services	?		
Savanna Agricultural Research Institute (SARI)	?	?	
Cocoa Research Institute of Ghana	?	?	?
MOFA-crops/agroforestry services	?	?	?
Dizengoff Ghana Ltd	?		
Forest Commission-Forest Service Division (FC FSD/ Plantations)		?	
Kwadoso Agriculture College	?	?	
CSIR-Cropn Research Institute	?		
Faculty of Forest Resources Technology of KNUST, Sunyani		?	
CSIR-Soil Research Institute	?	?	?
CSIR-FORIG, Savannah Research Centre			?
Resource Management Support Centre, Forestry Commission			?
Forest Services Division		?	

**Table 5.7: Other institutions involved in CA/AF (CAWT) technologies**

Other Organization that deals with AF/CA or both.	CA	AF	CAWT
Rural Youth Development Association (RUDYA), an NGO based in Ghana		?	
Ricerca e Cooperazione, an Italian NGO		?	
Forestry Commission of Ghana		?	
Farm Front Services	?		
CARE Intl. Ghana	?		
World Vision International	?		
ACDEP		?	
Formii international		?	
Ofuman Vegetable Growers Association			?
Brong Ahafo Tree Growers Association			?
MOFA			?
Forestry Commission		?	
Cocoa Research Institute of Ghana		?	
CSIR-Crop Research Institute			?
Kwame Nkrumah University of Science and Technology (KNUST)			?
Trax			?
World Vision International			?
Ministry of Food and Agriculture		?	
Rudeya		?	
FPPC community forestry management project		?	
Ministry of Food and Agriculture (MOFA)		?	
Ministry of Food and Agriculture (MOFA)	?		

### Government Ministries

The Ministry of Food and Agriculture (MOFA) is the lead agency and focal point of the Government of Ghana, responsible for developing and executing policies and strategies for the agriculture sector within the context of a coordinated national socio-economic growth and development agenda. By means of a sector-wide approach, the Ministry's plans and programmes are developed, coordinated and implemented through policy and strategy frameworks. The MOFA has Regional and District Agricultural Development Units and the Ministry is also supported by Line and Technical Directorates. The Regional Agricultural Development Units (RADU) is engaged in monitoring and backstopping activities, building the relevant database for agricultural planning, facilitating farmers/processors access to credit and markets and ensuring the efficient management of financial and institutional

resources for policy planning and implementation. The District Agricultural Development Units (DADU) objectives are to manage and co-ordinate the District Department of Food and Agriculture within the District Assembly; and to ensure the development and effective implementation of the district agricultural programmes.

Ministry of Lands and Natural Resources (MLNR) is responsible for the sustainable management and utilization of the nation's lands, forests, wildlife and efficient management of mineral resources for the country's socio-economic growth and development. This is achieved through efficient formulation, implementation, coordination, monitoring and evaluation of policies and programmes of sector agencies as well as promotion of sustainable forest, wildlife and mineral resource management and utilization.

### **Other Public Institutions**

Several public institutions and agencies play various essential roles in supporting the agricultural sector. These include:

- i. **Lands Commission**, set up to manage public lands efficiently, advice and facilitate good land delivery system in the country through proper documentation and good records keeping so as to contribute to commercial agricultural activities and the socio-economic development of the nation;
- ii. **Forestry Commission** Ghana, responsible for the regulation of utilization of forest and wildlife resources, the conservation and management of those resources and the coordination of policies related to them;
- iii. **Council for Scientific and Industrial Research (CSIR)**, which has the responsibility to generate and apply innovative technologies which efficiently and effectively exploit Science and Technology for socio-economic development in the critical areas of agriculture, industry, health and environment and improve scientific culture of the civil society; and
- iv. **Environmental Protection Agency (EPA)** responsible to co-manage, protect and enhance the country's environment, as well as seek common solutions to global environmental problems. The EPA achieves its mandate through an integrated environmental planning and management system established on a broad base of public participation, efficient implementation of appropriate programmes and technical services, giving good counsel on environmental management as well as effective and consistent enforcement of environmental laws and regulations.

### **Academic and Research Institutions**

Several academic and research institutions provide support to the agricultural sector in the area of research and training to meet professional and technical needs in the agricultural

sector. In addition, research and academia provide advisory services to the Government and private sector.

- i. **Cocoa Research Institute of Ghana (CRIG)** carries out research into problems relating to the production of cocoa, coffee, kola, sheanut and other indigenous oil tree crops which produce fats similar to cocoa butter. It also provides information and advice on all matters relating to the production of the crops. Organised on a multi-disciplinary basis, research is conducted in seven scientific divisions, as follows: Agronomy/ Soil Science, Plant Breeding, Entomology, Plant Pathology, Physiology/ Biochemistry, Social Science and Statistics and New Products Development. .
- ii. **CSIR-Crops Research Institute** conducts research into and develops improved varieties of food and industrial crops and their production technologies, to enhance food security and poverty reduction.
- iii. **CSIR-Savanna Agriculture Research Institute (CSIR-SARI)** provides farmers in the Northern, Upper East and Upper West Regions of Ghana with appropriate technologies to increase their food and fibre crop production based on a sustainable production system which maintains and/or increases soil fertility.
- iv. **CSIR-Soil Research Institute** is responsible for undertaking scientific research to generate information for effective planning, utilization and management of the soil resources of Ghana for sustainable agriculture, industry and environment.
- v. **CSIR-Water Research Institute** undertakes research into all aspects of water resources of Ghana in order to provide scientific and technical information and services needed for sustainable development, utilization and management of the resources for socio-economic advancement of the country.
- vi. **CSIR-Oil Palm Research Institute** has the responsibility to conduct sustainable and demand driven research aimed at providing Scientific and Technological support for the development of the entire oil palm and coconut industries in Ghana.
- vii. **CSIR-Forestry Research Institute of Ghana** undertakes forestry and forest products research to ensure sustainable management and utilization of Ghana's forest resources.
- viii. **College of Agriculture and Natural Resources (Kwame Nkrumah University of Science and Technology)** is mandated to train and equip graduates with the requisite academic and entrepreneurial skills in the areas of agricultural production and natural resource management for sustainable national development, in addition to carrying out research and extension services in these areas.

### **Agroforestry committees**

The National Agroforestry Policy recognised the fact that an organised and coordinated approach was required if agroforestry was to play a role in the promotion of sustainable

agricultural development. In the light of this, the Government of Ghana, with assistance from the UNDP and FAO through Project GHA/88/007 initiated a national programme to support agroforestry. The aim was to help establish and put in operation an Agroforestry Unit (AFU) within the Crops Services Department of the Ministry of Food and Agriculture (MOFA), and to establish a National Coordination Network between the Agroforestry Unit, the Government, and NGOs with agroforestry agenda. To ensure effective policy implementation and monitoring, three main stratified institutions were put in place: National Agroforestry Committee; Agroforestry Technical Sub-Committee, and Regional and District Agroforestry Committees (Asare, 2004).

### **5.3 Conclusions**

The study concludes that in general, adequate institutional frameworks exist that are favourable to CAWT. However, the study noted that there is low level of awareness of CAWT practices and poor coordination of such practices/activities in the countries with possible exception of Zambia. There is also very little or no coordination among all the various actors and stakeholders that develop and promote CAWT technologies in the other three countries. In many instances, CAWT activities are carried out in isolation by various actors and institutions. . This suggests that CA can best be promoted in collaborations with the existing CBO structures active at the community level. These results suggest that there is a need for formal institutional frameworks to incorporate existing local institutions in the efforts to scale-up adoption of CAWT. Institutional mechanisms are required to ensure that CAWT is seen as a concept beyond agriculture and promote it as a theme ensuring effective linkages between R&D activities. Conservation agriculture with trees needs to aim at broad sense of contributing to livelihood strategies and move towards forming more structures/frameworks with appropriate commercial/agribusiness strategies to create environment for increased rural employment in areas where it is adapted.

## **6. TOWARDS A REGIONAL FACILITATION MECHANISM FOR SCALING UP AGROFORESTRY BASED CONSERVATION AGRICULTURE**

### **6.1 Introduction and methodology**

This objective of this output was to develop knowledge on the type of partners and the process involved to establish a successful platform for scaling up agroforestry based conservation agriculture across the continent. The project was initiated by holding inception workshops in each of the four countries. The country focal persons were tasked to identify all stakeholders relevant to CAWT in their respective countries from government ministries, NGOs, research and academic institutions as well as upstream farmer institutions. The participants to each of these workshops expressed a desire to constitute a group that would lobby for national initiatives to upscale CAWT in the respective country. These informal groups later transformed to National CAWT Taskforces borrowing on the model of Zambia which already had an existing national CA taskforce as part of the southern Africa CA Regional Working Group (CARWG). The national taskforces held sessions with policy makers in their respective countries to demonstrate scientific evidence for adopting CAWT promotion policies. They also prepared draft national CAWT investment plans for which their respective governments could negotiate bilateral arrangements with development partners. The taskforce in Ghana faced several challenges because it was hosted by FORIG an institution based in a city far away from the government capital city and therefore they could not interact very frequently with national policy makers.

Although the project worked in the four Tier 1 countries, the implementation team is cognizant that CA and agroforestry has been advanced in many other African countries with similar challenges of up-scaling. Each nation, be it Morocco, Ethiopia or South Africa has its own approach, applicable to its livelihoods, hence the level of CA adoption. To develop a regional facilitation mechanism for up-scaling CAWT, there needs to be a collaboration of organizations with regional mandate for technology development and/or dissemination linking up with regional development and governance bodies as well as national initiatives in various countries to ensure efficient utilization of resources and minimal duplication. In the rest of this chapter, we point out some of the pertinent organizations for such a mechanism and explain how interactions can happen in a possible regional mechanism as proposed in the end of project workshop on 11<sup>th</sup> May 2012.

There are three bodies that can lay claim to pioneering the advancement of CA in Africa. They are all close working partners. They are ACT, the FAO of the United Nations and ICRAF. These organizations and their regional, national and local partners in national research institutions, NGOs and even the private sector have been and should be deeply involved in scaling up CAWT to the next and sustenance levels.

In more recent times, the efforts of all these and other partners in CA in the region were boosted by the formation of the technical wing of AU in the name of NEPAD. NEPAD went on to set-up the Comprehensive African Agriculture Development Programme (CAADP), among others. CAADP, a clearly written development framework went on to demand that African countries place Agriculture where it deserves, by dedicating more, in terms of economic growth focus and even national budgetary resource allocations. African nations are supposed to work through their own Regional Economic Communities and by developing national specific CAADP Compacts that will drive their development mechanisms.

## **6.2 The Africa Conservation Tillage Network**

The Africa Conservation Tillage (ACT) Network is now well established as the body to propel the advancement of CA in Africa. Although ACT is yet to make a dent on the work involved in coordinating an extremely complex landscape, she works closely with regional Governments, research institutions, NGOs, farmer organizations or groups, individual farmers and various business operators.

ACT has taken the leading role in various CA inculcating activities. ACT in partnership with others helped CA gain significant but limited mileage by hosting of the 3<sup>rd</sup> World Congress in Nairobi (Kenya) in 2005. ACT has grown in leaps since that time, leading and participating in various projects and CA advancement initiatives. ACT has described herself as the One-Stop Information Facility for CA in Africa. ACT has offices in Kenya, Ouagadougou, Tanzania and Zimbabwe. She works with various partners across all levels, some of which are national Governments and NGOs such as CRS, SOS Sahel, IFDC, Agrinovia, Réseau MARP.

ACT has defined her operational themes as follows:

- Awareness creation and advocacy, through campaigns, lobbies, exhibitions etc.
- Capacity building: training beneficiaries at all levels, influencing formal school curricula, demonstrations, exchange visits, e-forums etc.
- Networking & Partnership building: knowledge and information dissemination, building value chain linkages; linking farmers to private enterprise support etc.
- Research and development: including climate change mitigation efforts.



- Special programmes touching on environment; livelihoods of vulnerable groups (women and youth) including those suffering under HIV/AIDS.

### **6.3 Food and Agriculture Organization of the United Nations (FAO)**

In realization of a need for a regional stakeholder coordination body that would help form and reform national task force efforts the FAO office for Southern Africa formed the Conservation Agriculture Regional Working Group (CARWG). This was founded by the Expert Consultation Group that sat in Harare in 2007.

Today CARWG has an Executive Committee with a Chair and a Secretariat. The organization operates under several Thematic Groups, which develop annual work plans, namely:

- Research, Monitoring and Evaluation led by FAO
- Capacity Building, Extension, Knowledge and Publicity led by ACT
- Inputs and Equipments led by FAO and
- Policy Development and Advocacy led by FANRPAN

CARWG reports her major achievements as:

- Annual meetings
- CA case studies
- M&E Toolkit development and training
- 3 Policy maker study tours
- Technical Briefs
- Training of Trainers
- Regional Symposium 2011
- Funds for NCATF programmes

CARWG has made great in-roads in her mandate area (the SADC region) as observable in South Africa where some 300,000 ha has been put under CA, mostly by large scale farmers in No-till Clubs, Zambia where some 400,000 smallholder farmers are practicing CA led by the efforts of a Farmers Union and Zimbabwe where a 2012 survey has reported some 372,000 CA farmers. In Zimbabwe this number has been achieved through emergency support which will need continued support for subsidized inputs if sustained growth will be achieved (Ager, 2012).

Ager (2012) reported a tripartite climate change initiative (between SADC, COMESA and EAC) and associated projects that are under formation. These efforts will feature:

1. Adoption of African Climate Solutions hence investment frameworks to access climate adaptation funds,
2. Enhanced adoption of Climate Smart Agriculture (CSA),
3. Strengthened research & training capacity,
4. Climate vulnerability assessments to help understand applicable mitigation solutions.
5. Establishment of a regional facility to invest in CSA

Indeed plans in this regard are at an advanced stage, namely a 5 year-programme on Climate Change Adaptation and Mitigation in Eastern & Southern Africa:

- Involving 27 countries of COMESA, EAC, SADC
- To be implemented by RECs, Governments and partners including FAO, ACT and others,
- Participating donors including EU (€4 m), Norway (US\$20m) and DfID Investment Facility (£38m)

Ager (2012) reported that FAO sees her role in this movement as one to support and facilitate national CA task forces and CA regional working groups, including research programmes to:

- Develop Investment Frameworks
- Conduct 14 minor pilot Investment Projects

#### **6.4 World Agroforestry Centre (ICRAF)**

Recently, the CA and agroforestry research and development communities have mutually recognized the value of integrating fertilizer trees and shrubs into CAWT systems. The gains are in the dramatic enhancement of both fodder production and soil fertility (FAO 2010; FAO 2011; see Figure 6.1). Practical systems for intercropping fertilizer trees in maize farming have been developed and are being extended to hundreds of thousands of farmers in Malawi and Zambia (Ajayi et al 2011). The portfolio of options includes intercropping maize with *Gliricidia sepium*, *Tephrosia candida* or *Cajanus cajan*, or using trees such as *Sesbania sesban* as an improved fallow. One particularly promising system is the integration of the *Faidherbia albida* into crop fields. *Faidherbia* is an indigenous African acacia that is widespread on millions of farmer's fields throughout the eastern, western, and southern regions of the continent (Garrity 2011).

*Faidherbia albida* is highly compatible with food crops because it is dormant during the rainy season. It exhibits minimal competition, while enhancing yields and soil health (Barnes and Fagg 2003). Several tons of additional biomass can be generated annually per hectare to accelerate soil fertility replenishment, provide additional livestock fodder. Numerous

publications have recorded increases in maize grain yield when it grown in association with *Faidherbia*, ranging from 6% to more than 200% (Barnes and Fagg 2003), depending on the age and density of trees, agronomic practices used, and the weather conditions.

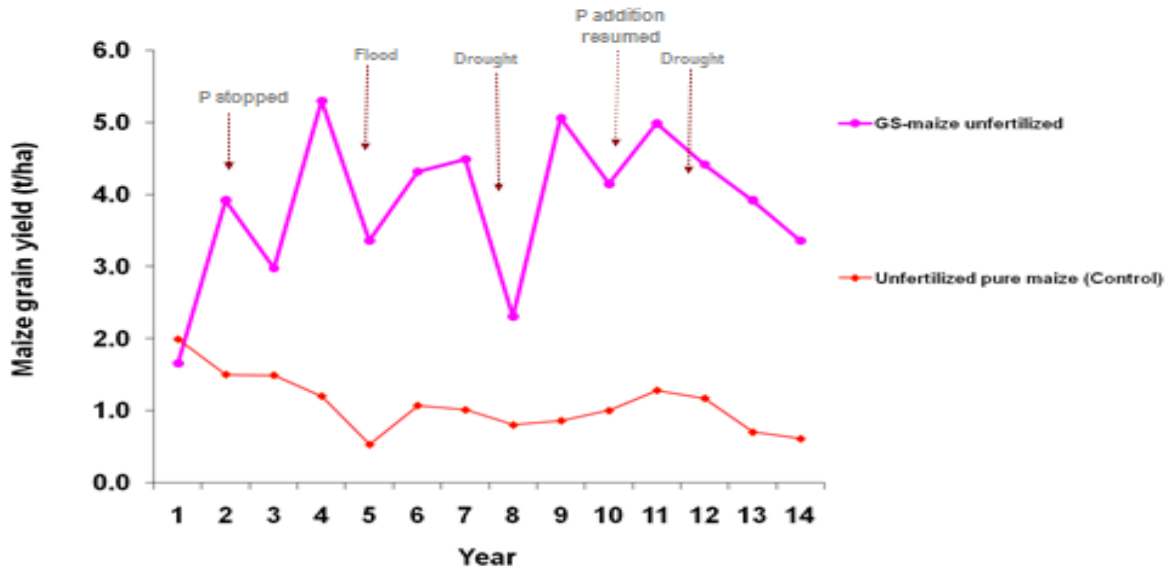


Figure 6.1: Long-term maize yield without fertilizer in *Gliricidia* Farming System

(Source: Garrity et al. 2010)

### 6.5. The African Union - CAADP and Regional Economic Communities (RECS)

The advent of the African Union (AU) can be described as an event of great magnitude in the institutional evolution of the continent. On 9<sup>th</sup> September 1999, the Heads of State and Government of the Organisation of African Unity (OAU) issued a Declaration (the Sirte Declaration) calling for the establishment of an African Union, with a view to accelerating the process of integration in the continent to enable it play its rightful role in the global economy while addressing multifaceted social, economic and political problems compounded by certain negative aspects of globalisation. The AU (2012) reports that the vision of the AU is that of “**an integrated, prosperous and peaceful Africa, driven by its own citizens and representing a dynamic force in the global arena.**” The AU has shifted focus from supporting liberation movements in the erstwhile African territories under colonialism and apartheid, as envisaged by the OAU since 1963 and the Constitutive Act, to an organisation spear-heading Africa’s development and integration. The Union has made good attempts at uniting Africa socially, economically and even politically, with significant success. The Union’s continental processes, some of them originating from efforts of particular

countries and their neighbours, have resulted in the formation of Regional Economic Communities (RECs) namely:

- 1) Common Market for Eastern and Southern Africa (COMESA)
- 2) Southern African Development Community (SADC)
- 3) Economic Community of West African States (ECOWAS)
- 4) East African Community (EAC)
- 5) Intergovernmental Authority on Development in Eastern Africa (IGAD)
- 6) Economic Community of Central African States (ECCAS)
- 7) Community of Sahel-Saharan States (CEN-SAD)
- 8) Union du Maghreb Arabe (Arab Maghreb Union) (UMA)

Africa's leaders envision agriculture as an engine for overall economic development. Sustained agricultural growth at a much higher rate than in the past is crucial for reducing hunger and poverty across the Continent, in line with Millennium Development Goals (FARA, 2006). Established in 2001 under the AU and spearheaded by African leaders, is the New Partnerships for African Development (NEPAD), a blueprint for Africa's development in the 21st century that provides unique opportunities for Africa to address the critical challenges facing the continent, including the attainment of MDGs and other continental and internationally agreed upon goals.

The primary objectives of NEPAD are poverty eradication, promotion of sustainable growth and development, and the empowerment of women through building genuine partnerships at country, regional and global levels. NEPAD's programme of action is a detailed action plan derived from the NEPAD Strategic Framework document and the NEPAD Initial Action Plan, adopted by the African Union Summit in Durban in June 2002. It is a holistic, comprehensive and integrated sustainable development initiative for the revival of Africa. The NEPAD Agency was established by the 14<sup>th</sup> AU Summit decision as the institutional vehicle for implementing the AU Development agenda. Designated as the technical body of the AU, the core mandate of the Agency is to facilitate and coordinate the implementation of regional and continental priority programmes and projects and to push for partnerships, resource mobilisation and research and knowledge management (AU, 2012).

The NEPAD Secretariat is not responsible for the implementation of development programs itself, but works with the RECs - the building blocks of the AU. The role of the NEPAD's secretariat is one of coordination and resource mobilisation. Many individual African states have also established national NEPAD structures responsible for liaison with the continental initiatives on economic reform and development programs. The key NEPAD partners are:

- UN Economic Commission for Africa (UNECA)

- African Development Bank
- Development Bank of Southern Africa (DBSA)
- Investment Climate Facility (ICF)
- African Capacity Building Foundation
- Office of the UN Under-Secretary-General and Special Adviser on Africa
- IDC (The Industrial Development Corporation) - Sponsor of NEPAD

More specifically, the NEPAD vision for Africa holds that, by 2015, Africa should:

- Attain food security
- Improve agricultural productivity to attain a 6 per cent annual growth rate
- Develop dynamic regional and sub-regional agricultural markets
- Integrate farmers into a market economy
- Achieve a more equitable distribution of wealth

NEPAD has issued a Comprehensive African Agriculture Development Programme (CAADP) endorsed by African Heads of State and Governments as a vision for the restoration of agricultural growth, food and nutrition security, and rural development in Africa. As such, CAADP emanates from and is fully owned and led by African governments. Although continental in scope, it is integral to national efforts to promote agricultural growth and economic development. As a common framework for agricultural development and growth for African countries, CAADP is based on: (i) the principle of agriculture-led growth as a main strategy to achieve the MDG of poverty reduction, (ii) the pursuit of a 6 per cent average annual agricultural sector growth rate at national level by 2015, (iii) the allocation of 10 per cent of national budgets to the agricultural sector, (iv) the exploitation of regional complementarities and cooperation to boost growth, (v) the principles of policy efficiency, dialogue, review, and accountability, shared by all NEPAD programs, (vi) the principles of partnerships and alliances to include farmers, agribusiness, and civil society communities, and (vii) the implementation principles, which assign the roles and responsibilities of program implementation to individual countries, coordination to designated regional economic communities (RECs), and facilitation to the NEPAD Secretariat.

CAADP defines four major intervention areas, or Pillars, to accelerate agricultural growth, reduce poverty, and achieve food and nutrition security in alignment with the above principles and targets:

- Pillar I: Extending the area under sustainable land management and reliable water control systems
- Pillar II: Improving rural infrastructure and trade-related capacities for market access

- Pillar III: Increasing food supply, reducing hunger and improving responses to food emergency crises
- Pillar IV: Improving agriculture research, technology dissemination and adoption (FARA, 2006; AU, 2008; CAADP, 2012).

The CAADP Pillar 1 Framework is critical in scaling up of CAWT practices in Africa due to its focus on sustainable land management. The framework has been developed over the past four years and brings together four key elements of the CAADP process, as follows:

- 1) Sustainable Land Management (SLM): Undertakes to embrace and build on the strategic vision, country support tools and sustainable land management framework developed through NEPAD/TerrAfrica as part of the programme of support mobilised by NEPAD under CAADP and the Environment Action Plan (EAP) to assist countries in scaling up sustainable land and water management practices.
- 2) Agricultural Water Development: Aims to ensure that issues arising from initiatives led by several key CAADP and TerrAfrica partners are well reflected. This is mainly done through a collaborative initiative involving the African Development Bank (AfDB), Food and Agriculture Organisation of the United Nations (FAO), the International Fund for Agriculture Development (IFAD), International Water Management Institute (IWMI) and the World Bank on support to enhance investment and sustainable productivity in agriculture water.
- 3) Land Policy/Land Administration: Addressing issues related to land policy and land administration is critical to the achievement of sustainable land and water management objectives. The outputs from the work spearheaded by the African Union Commission (AUC) and Economic Commission for Africa (ECA), the Africa Development Bank (AfDB) and various other partners on development of a specific land policy and land administration framework has accordingly been incorporated into the Pillar 1 Framework.
- 4) CAADP Roundtable: Ensures that the principles and modalities for engagement and integration of sustainable land and water management into the country and regional level CAADP implementation processes (roundtables) is a key element of the Pillar 1 framework itself.

The role of the framework is to promote partnerships between international, regional, national, district and local/community level stakeholders with the long term goal of restoring, sustaining and enhancing the productive and protective functions of Africa's land and water resources by combating the interrelated problems of land degradation, food insecurity and rural poverty. It will seek to do this through the implementation of a long-term, well-funded and multi-level programme with the short to medium term objectives of:

- Building capacity and strengthening the enabling institutional, policy, legislative, budgetary and strategic planning environment for SLM and water strategies; and
- Mainstreaming sustainable land management and water strategies within country-driven programmes to remove the barriers and bottlenecks to financing and scaling-up on the ground, successful technologies and approaches.

Specifically, the framework aims to provide support for: (i) coalition building amongst the key stakeholders, regional integration, coordination and partnerships, (ii) empowerment of national and regional stakeholders, (iii) improvement of the collection, management and dissemination of knowledge related to SLM and water strategies, (iv) identification, mobilisation and harmonisation of the investment funds required for the promotion of SLM and water strategies at the local and country levels (and as required sub-regional and regional levels) within nationally determined strategic investment programmes, and (v) scaling up investments and ensuring a more reliable, broad-based and sustained flow of funds for agricultural water. The framework exists to help countries: (i) review, revise, harmonise and coordinate their efforts at the policy, strategy, technical and programme levels, (ii) expand and consolidate actions that support sustainable land and water management, (iii) benefit from qualitatively and quantitatively increased flows of knowledge, information and expertise to and from members, (iv) better mobilise and channel financial resources, and (v) provide and obtain mutual encouragement and support in their commitment and efforts towards sustainable land and water management (AU-NEPAD, 2009a).

The ultimate objective of CAADP Pillar II is to accelerate growth in the agricultural sector by raising the capacities of private entrepreneurs, including commercial and smallholder farmers, to meet the increasingly complex quality and logistics requirements of domestic, regional, and international markets, focusing on strategic value chains with the greatest potential to generate broad-based income growth and create wealth in the rural areas and the rest of the economy. The Pillar agenda focuses on policy and regulatory actions, infrastructure development, capacity-building efforts, and partnerships and alliances that

could facilitate smallholder-friendly development of agricultural value chains to stimulate poverty-reducing growth across African countries. The actual implementation of the agenda under Pillar II is to be carried out through the following main clusters of activities, or strategic areas, guided by the vision described as: raising competitiveness and seizing opportunities in domestic, regional, and international markets; and investing in commercial and trade infrastructure to lower the cost of supplying domestic, regional, and international markets (AU-NEPAD, 2009b).

CAADP's Pillar III focuses on the challenge of ensuring that vulnerable populations have the opportunity to contribute to and benefit from agricultural growth. CAADP Pillar III also recognises the need to reduce the vulnerability of poor households to economic and climatic shocks. This is due to the clear linkages between repeated exposure to shocks, the erosion of household assets and coping mechanisms, and deepening poverty. Finally, Pillar III highlights the linkages between poverty, hunger and malnutrition, in relation to the enormous threat they pose to the current and future productivity of Africa. The framework for the implementation of activities under CAADP Pillar III is the Framework for African Food Security (Pillar III/FAFS). This framework sets out Pillar III's vision as to increase resilience by decreasing food insecurity and linking vulnerable people to opportunities for agricultural growth. It also defines its relevance to the overall CAADP agenda and suggests actions at regional and country level (AU-NEPAD, 2009c).

The Forum for Agricultural Research in Africa (FARA) has, in consultation with stakeholders, developed the Framework for African Agricultural Productivity (FAAP). This framework addresses the challenges of CAADP Pillar IV and its aim to achieve strengthened agricultural knowledge systems through delivering profitable and sustainable technologies that are widely adopted by farmers resulting in sustained agricultural growth. This will require major improvements in African capacity for agricultural research, technology development, dissemination and adoption, together with enabling policies, improved markets and infrastructure. The purpose of FAAP is to guide and assist stakeholders in African agricultural research and development to meet the objectives of CAADP Pillar IV and the African growth agenda by: 1) empowering farmers, livestock producers and their organisations; 2) strengthening institutions, both public and private; 3) promoting harmonisation of internal and external actions and actors; and 4) generating increased investment. The consultation process through which FAAP was developed concludes that the priorities of CAADP Pillar IV for agricultural research, technology dissemination and adoption require significant changes in approaches to: (i) strengthening Africa's capacity to build human and institutional capacity; (ii) empowering farmers, and (iii) strengthening agricultural support services (FARA, 2006).



To achieve the four key objectives/Pillars of CAADP, African governments have agreed to increase public investment in agriculture by a minimum of 10 per cent of their national budgets. This collaborative effort has resulted in a significant harmonisation of donor support for CAADP activities and investment programmes. The result is the CAADP Multi-donor Trust Fund, hosted at the World Bank. This is meant to channel financial support to CAADP processes and investments. CAADP describes the CAADP Multi-donor Trust Fund as a flexible yet systematic, efficient and reliable way to harmonise priorities, allow economies of scale, increase the efficiency and effectiveness of financial resources, target specific gaps in financing, capacity and technology, facilitate partnerships and coalition building among African institutions, partners and donors, complement existing resources mobilised around CAADP Pillars and other thematic priorities (CAADP, 2012).

### **6.6 The role of RECs in scaling up CAWT within the policy frameworks of CAADP**

RECs (i.e. COMESA, UMA, EAC, SADC, ECOWAS, ECCAS, IGAD, and CEN-SAD) are seen as critical in facilitating the up scaling of CAWT practices in Africa under the umbrella of the four Pillars of CAADP. This is due to the fact that agriculture is an important engine for economic growth and development in most regions of Africa and is a high priority on the integration agenda and the achievement of other regional aspirations. This became apparent during the process of developing national CAADP compacts<sup>2</sup>, where it was decided that: (i) national compacts have to be aligned with agricultural policies of regional and sub-regional groupings, (ii) member states need guidance on how to deal with agricultural priorities that transcend their national frontiers, and (iii) member states have capacity gaps in effective planning and implementation of CAADP processes. However, no agency or institution has been charged with the development of such capacities at the regional level. Therefore, RECs have two significant and yet distinct roles to play, i.e. harmonisation and facilitation. The detailed roles and responsibilities at regional level include the following: creation of investment programmes that will reduce food insecurity, improvement of information sharing on issues of common interest, capacity building in agricultural forecasts and early warning systems, improvement of agricultural infrastructure (e.g. storage, marketing and transport systems), minimising the effects of global warming and climate change, and effective management of trans-boundary resources such as water bodies.

The CAADP initiative at a regional level will play a pivotal role in the consolidation, strengthening and value addition of REC member states' efforts in improving agriculture

---

<sup>2</sup> National CAADP compacts are high-level agreements between governments, regional representatives and development partners for a focused implementation of CAADP within the respective country. They are meant to detail programmes, projects and other investments that the various stakeholders can buy into and that address national priorities (FANRPAN, 2010).

development. The compacts will also encourage the identification of strategic options to directly address poverty reduction at national level in support of national compacts. The identification of regional investment programmes requires a regional approach if they are to address common trans-boundary constraints to agricultural development. The compacts will provide the glue to link countries together in ways that accelerate agricultural growth and improve food and nutrition security. CAADP will largely address itself on high-end policy promotion, advocacy and resource mobilisation functions while giving discretion to member states to implement their own compacts in the style and with the approach they consider most befitting and appropriate.

The 'CAADP roundtable' is fundamental for the successful implementation of CAADP at national level. It is an iterative learning process comprising analysis, design, implementation and evaluation of agricultural investment programmes. The actors involved in country process include: government representatives, REC representatives, CAADP focal points, Civil Society Organisations (CSOs), Farmer Organisations, Private Sector and Development Partners. The 'country process implementation' focuses on identification of growth options leading to specific core activities, which are then clearly outlined in the national compact document. Once the national compact is signed, the development and implementation of agricultural investment plans begins. In a nutshell, the role of RECs in facilitating nationally identified CAWT up scaling programmes will involve:

- Assisting in the harmonisation, streamlining and prioritisation of the agricultural sector development initiatives.
- Facilitating compliance of agreed upon commitments regarding agriculture financing and rural development. This will include meeting the commitment to allocate 10% of the national budget agriculture at country level through a regional approach that provides a favourable policy, infrastructural, and investment environment to support country efforts beyond national borders.
- Supporting the drive for the commercialisation and diversification of agriculture in the short to long term through linking farmers at country level to markets across the region (FANRPAN, 2010).

Based on existing RECs and CAADP structures, it is apparent that the most feasible pathways to promoting the scaling up of CAWT at national level would be through National Task

Forces<sup>3</sup> (NTFs). This could be achieved by among others: NTFs develop national CAWT advancement programmes; ensuring the programmes they build fit into their national situation and agenda; tapping into partnership opportunities with key stakeholders and champions of CAWT; developing investment plans under the themes that can be easily accommodated under NEPAD/CAADP's four Pillars, with special emphasis on Pillar 1 (Sustainable Land and Water Management); generation of own funds from government ministries, agencies, development partners or the private sector and; ensure that CAWT advancement programmes are stakeholder and beneficiary targeted, hence absolutely clear on scope, roles, and deliverables to meet agreed upon outputs. These NTFs may then be integrated and harmonised to form a regional platform geared towards scaling up CAWT in sub Saharan Africa.

#### **6.6.1 National into regional structure and policy towards accelerated growth of CAWT at panacea level: Some pertinent questions**

- Are the recommendations of REC guided policy and strategic plan interventions, CAADP and arising CAADP compacts marrying adequately with solidly grounded national policy, plans and strategies?
- Are national plans for the all-important agricultural sector (carrying 80% of Africa's population) loaded with commitment to grow the smallest of farmers from an agribusiness perspective?
- Are countries providing for adequate own resources with clear guidelines on where and how development partners can chip in? Or are donors still sought to drive such a pertinent agenda?
- Have clear and committed CAWT, SLWM and even Natural Resource Conservation Investment Plans been well documented with the inputs of all stakeholders? Have such Plans been articulated to grow out of the institutional and practice structures of the past as to create a new and innovative beginning?

With the above questions answered by organized and representative stakeholder groups (see the representative platform proposed below and captured in Figure 6.2), CAWT will see

---

<sup>3</sup> National platforms consisting of relevant sector representatives (government, development partners, academia, research bodies and non-governmental organizations) aimed at identifying opportunities and developing synergies geared towards enhancing scaling up of CAWT at country level.

Africa grow in ways never previously imagined. Indeed this Continent, the Last Frontier of observable high impacts that arise from relatively low external input agendas, needs CAWT value-chains to lead the way for Africa's long awaited agribusiness led revolution. CAWT is the bus to generate the vibrant participation of the majority smallholder farmers to drive the mandatory agriculture-led development agenda.

## **6.7 The proposed Regional Platform for fast-tracking CAWT initiatives from national to regional levels for sustained growth and impact**

The inputs of the proposals made at the End of Project Workshop in Arusha on May 11<sup>th</sup>, 2012) are captured in Figure 6.2. The chart shows the architecture developed to be domiciled under the African Union and how delivery of development initiatives is meant to flow bottom-up as well as top-down, between AU council of Ministers (from Agricultural Development and SLWM) and NEPAD-CAADP, via the RECs and into the country programmes. The bottom-left end of the Chart shows an example from the East African Community, and how each of the RECs can be presented as inclusive of the member countries.

It is clear from the background, various presentations, and report items captured in the various studies conducted under this project that:

- Despite much progress, not enough achievements have been made in inculcating CA practice into the national and regional Sustainable Land and Water Management (SLWM) programmes or national policy interventions. Not enough since development of the NEPAD-CAADP climate change adaptation strategy (NEPAD-CAADP-CAS) framework and her well thought out regional thrusts and selection of its Special Management Team that took place in 2009.
- Meanwhile the growing and severe, observable impacts of climate change have continued to hit, growing new and urgent interest in the benefits of CAWT from communities, to nations, RECs, development partner agencies and other stakeholders, at all levels.
- There are new opportunities in re-building and re-focusing efforts via CAWT National Task Forces. The way to a robust and representative national to regional process of growing CAWT interventions is captured in the chart below and it is thought out structurally in the representational steps listed below.

The nature and size of a National into Regional Task Force for pushing CAWT agenda and activities from farm to policy levels support is absolutely needed. The protocol is one, beginning with representative countries where CAWT practice is well established and including the CAWT countries that participated in this project namely Zambia, Tanzania, Kenya and Ghana.

1) Establish a, no more than 10 Member SLWM-NTF, National CAWT Task-Force (NTF) composed of members from (but not limited to) the following primary institutions which generally contribute SLWM efforts and resources in countries (see the Green bottom-box of Figure 6.2):

- Government Agencies,
- NGOs,
- Research and Development (FARA, ASARECA, NARI or CGIAR),
- CAADP Focal Points existing in various countries,
- United Nations' Agencies (FAO, UNEP, UNIDO, etc.)
- AfDB, IFAD and World Bank,
- Farmers Unions or Federations including Federation of African Women Farmers,
- Civil Society Organizations and Regional Development Projects (e.g. AGRA, RUFORUM, AFAS etc.)
- National CAWT Working Groups,
- Private Sector operators,
- Finance Institutions and Development Partners etc.

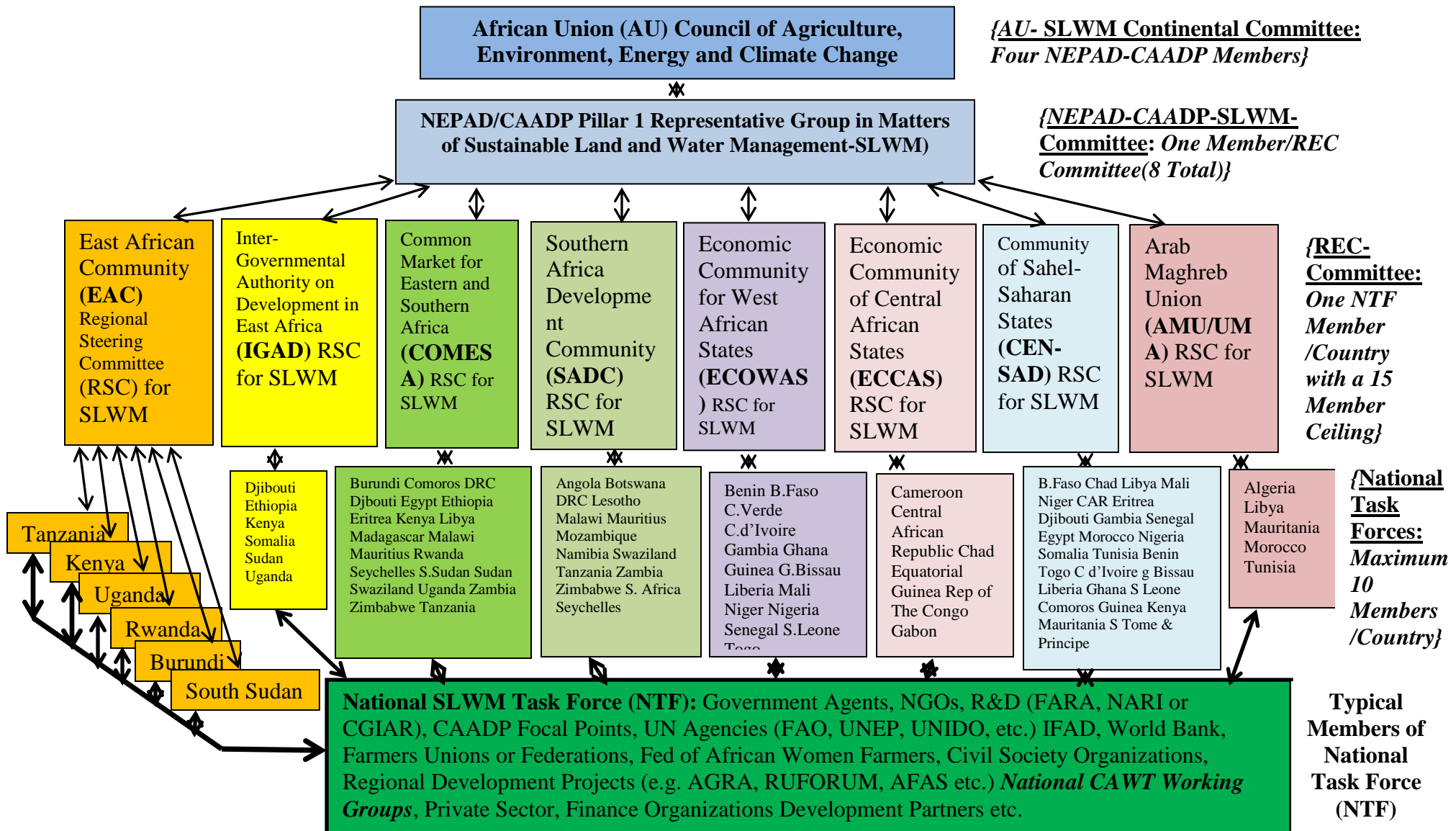
The National Task Forces will generate own stakeholder analysis, representation and roles for fast-tracking efforts and impacts, management structure, TOR, agenda, strategic and logical frameworks, investment plans with clear and water-tight budgets, M&E contents and timelines etc.

2) Each national task force will have a Chair or other member (as appropriate and efficient) to represent their country at the development agendas and gatherings of the particular REC (to constitute no more than 15 Member REC-SLWM-Committee). Different RECS may have been differently founded and with development agenda. Where a country belongs to more than one REC, a NTF may want to have different representatives at these. This will help NTF representatives specialise on the strategic plans and opportunities available at their roundtables, while building persistence and continuity. NTF member representation at the RECs should be limited to the number of member countries with a ceiling of 15 persons (whichever is lower).

- 3) The NEPAD-CAADP-Committee will be composed of eight members, one from each of the 8 RECs recognised by the African Union (AU) – (to constitute no more than 8 Member NEPAD-CAADP-SLWM Committee). These 8 members may want to define who represents the SLWM at various CAADP gatherings, including gatherings held under the other CAADP Pillars, namely: Infrastructure & Market Access (Pillar 2); Food Supply & Hunger Response (Pillar 3); and Agricultural Research & Technology Dissemination (Pillar 4). It is noteworthy that if SLWM, of which CAWT is part and parcel, is implemented under the more promising Value-Chain approach, all pillars will be important for sustained CAWT advancement.
  
- 4) It is proposed that at the AU level, SLWM and CAWT agenda shall be propelled and represented by a (no more than **4 Member AU-SLWM- Continental Committee**). These four members will have been selected from the 8 member NEPAD level (NEPAD-CAADP-SLWM Committee).

It is believed that with this kind of hierarchical representation, efforts like those of variously discussed NEPAD-CAADP efforts and strategic plans for advancing SLWM and other pillar initiatives in the region will be firmed, to grow in leaps and bounds. This is a very necessary structure to be promoted by NEPAD Pillar 1, to bring structure to a continent that is complicated in terms of representation, persistence and focus for sustained growth.

**Figure 6.2: The Proposed Regional Platform:**  
*From National to Regional Partnership and Representation Structure*



**Figure 11: Integrating CAWT in National and Regional Sustainable Land and Water Management Initiatives and Economic Communities**

## REFERENCES

African Union (AU) (2008). Comprehensive African Agriculture Development Programme (CAADP) Pillar III: framework for African food security. 4<sup>th</sup> African Union ministers of agriculture. February 26<sup>th</sup> – 27<sup>th</sup>, 2008, Addis Ababa, Ethiopia.

African Union (AU) (2012). AU in a nutshell. Available on: [www.au.int/en/about/nutshell](http://www.au.int/en/about/nutshell). Accessed on 28th May 2012.

African Union (AU) -NEPAD (2009a). The CAADP Pillar I: framework for sustainable land and water management. AU and NEPAD. Available on: [www.caadp.net/pdf/](http://www.caadp.net/pdf/). Accessed on: May 29<sup>th</sup> 2012.

African Union (AU) -NEPAD (2009b). The CAADP Pillar II: framework for improving rural infrastructure and trade related capacities for market access. AU and NEPAD. Available on: [www.caadp.net/pdf/](http://www.caadp.net/pdf/). Accessed on: May 29<sup>th</sup> 2012.

African Union (AU)-NEPAD (2009c). The CAADP Pillar III: framework for African food security. AU and NEPAD. Available on: [www.caadp.net/pdf/](http://www.caadp.net/pdf/). Accessed on: May 29<sup>th</sup> 2012.

Ager M, 2012. CA Coordination in Southern Africa. A paper presented at the Stakeholder Sharing Workshop Elementaita, Naivasha Kenya, 30th – 31st May 2012 FAO Water Resources Management Office. martin.ager@fao.org

Apina, V, Wamai, P.,Mwangi P.K., (2007). Laikipia District. In: Kaumbutho and Kienzle (eds) Conservation agriculture as practised in Kenya: two case studies: Laikipia and Siaya districts. Pp. 41.

Barnes R.D., Fagg C.W. (2003) *Faidherbia albida*. Monograph and Annotated Bibliography. Tropical Forestry Papers No 41, Oxford Forestry Institute, Oxford, UK.

Boahen, P., Dartey, B.A., Dogbe, G. D., Boadi, E. A., Triomphe, B., Daamgard-Larsen, S., Ashburner, J. (2007). Conservation agriculture as practised in Ghana. Nairobi. African Conservation Tillage Network, Centre de Coopération Internationale de Recherche Agronomique pour le Développement, Food and Agriculture Organization of the United Nations.

Buresh R.J., Sanchez, P.A., Calhoun, F. (eds.) (1997). Replenishing soil fertility in Africa. SSSA Special Publication Number 51, Soil Science Society of America. Madison, Wisconsin, USA.



CAADP (2012). The Comprehensive Agriculture Development Programme. Available on: [www.caadp.net/about-caadp.php](http://www.caadp.net/about-caadp.php). Accessed on: May 29<sup>th</sup> 2012.

Central Intelligence Agency (CIA) World Fact Book (2010). Available on: [www.cia.gov/library/publications/the\\_world\\_fact\\_book/geos/ke.html](http://www.cia.gov/library/publications/the_world_fact_book/geos/ke.html). Accessed on 4th October 2011.

FANRPAN (2010). Towards a COMESA regional CAADP compact: framework for the development of a COMESA regional CAADP compact. Food, Agriculture and Natural Resources Policy Analysis Network (FANRPAN), Pretoria, South Africa.

FAO. 2010. An international consultation on integrated crop-livestock systems for development. Integrated Crop Management Vol 13. Rome: FAO. 79 p.

FAO 2011. Save and Grow. A policymaker's guide to the sustainable intensification of smallholder crop production. Rome: FAO. 103 p.

Franzel, S., Phiri, D. & Kwesiga, F. (2002). Assessing the adoption potential of improved fallows in eastern Zambia. In S. Franzel and S.J. Scherr, eds. Trees on the farm: assessing the adoption potential of agroforestry practices in Africa, pp. 37–64. Wallingford, UK, CABI.

Food and Agriculture Organization (FAO). (2007). Agriculture and Consumer Protection Department. Rome, Italy. Available from: <http://www.fao.org/ag/ca/>

Forum for Agricultural Research in Africa (FARA) (2006). Framework for African agricultural productivity/Cadre pour la productivite agricole en Afrique. FARA, Accra, Ghana.

Garrity D.P. 2011. Making Conservation Agriculture ever-green. World Agroforestry Centre (ICRAF), P O Box 30677-00100, Nairobi, Kenya; [d.garrity@cgiar.org](mailto:d.garrity@cgiar.org) Golden Valley Agriculture Research Trust (GART) (2008). GART Yearbook. Farmer Publications Ltd, Lusaka, Zambia.

Garrity, D., Akinnifesi F., Ajayi, O., Sileshi G. W., Mowo, J.G., Kalinganire, A., Larwanou, M and Bayala, J. 2010. Evergreen Agriculture: a robust approach to sustainable food security in Africa. Food Security. 2(3): 197-214.

Gitau, R., Kimenju, S., Kibaara, B., Nyoro, J., Bruntrup, M. and Zimmermann, R. (2008). Agricultural policy making in sub-saharan Africa: Kenya's past policies. Working paper series 34/2008 – Tegemeo Institute of Agricultural Policy and Development, Egerton University, Kenya.

Government of Kenya (2004). Strategy for revitalizing agriculture, 2004-2014. Ministry of Agriculture and Ministry of Livestock and Fisheries Development (2004). Government Printer, Nairobi, 116p.

Government of Kenya (2010) Agricultural Sector Development Strategy 2010-2020. Government Printer, Nairobi.

Government of Zambia (2006). Draft land policy. The ministry of lands of Zambia. Available on: [www.scribd.com/zambian-economist/d/3671350/zambia-draft-land-policy-2006](http://www.scribd.com/zambian-economist/d/3671350/zambia-draft-land-policy-2006).

IFAD (2011a). Enabling poor people to overcome poverty in Kenya. International Fund for Agricultural Development. Nairobi, Kenya.

IFAD (2011b). Smallholder conservation agriculture: rationale for IFAD involvement and relevance to the East and Southern Africa region. International Fund for Agricultural Development (IFAD) report.

Kabwe G., Bigsby H., Cullen R. (2009). Factors influencing adoption of agroforestry among smallholder farmers in Zambia. Paper presented at the 2009 NZARES Conference Tahuna Conference Centre – Nelson, New Zealand. August 27-28, 2009.

Kannegieter, A. (1967). Zero cultivation and other methods of reclaiming Pueraria fallowed land for food crop cultivation in the forest zone of Ghana. Trop. Agriculturist Vol. CXXVIII.

Kannegieter, A. (1969). The combination of short- term Pueraria fallow, zero cultivation and fertilizer application. Its effect on a following maize crop. Trop. Agriculturist Vol. CXXV N° 3 and 4

Kaumbutho Pascal, Kienzle Josef (eds), 2007. Conservation agriculture as practised in Kenya: two case studies. Nairobi. African Conservation Tillage Network, Centre de Coopération Internationale de Recherche Agronomique pour le Développement, Food and Agriculture Organization of the United Nations.

MACO (2004). National Agricultural Policy 2004-2015. Ministry of Agriculture and Cooperatives. Lusaka, Zambia.

Mazvimavi, K. (2011). Socio economic analysis of conservation agriculture in Southern Africa. FAO regional emergency office for Southern Africa.

McCarthy, N., Lipper, L. Branca, G. (2011). Climate smart agriculture: smallholder adoption and implications for climate change adaptation and mitigation. Working paper, FAO, Rome.

MFNP (2006). Fifth National Development Plan 2006-2010. Ministry of Finance and National Planning. Lusaka, Zambia.

MOFA, (2011). Agriculture in Ghana: Facts and Figures, 2010. Ministry of Food and Agriculture, Accra, Ghana.

Murage E.W., Karanja K.N., Smithson P.C. and Woomer P.L. (2000). Diagnostic indicators of soil quality in productive and non-productive small holders' fields of Kenya's central highlands. *Agricultural ecosystems*, 79; pp 1-8.

Mwangi, W., Verkuil, H., Bisanda, S. (1996). Gender Differentials in Adoption of Improved Maize Production Technologies in Mbeya Region of the Southern Highlands of Tanzania. CIMMYT/ United Republic of Tanzania.

NEMA (2012). National Environment Policy. Available at: [www.environment.go.ke](http://www.environment.go.ke). Accessed on: May 25<sup>th</sup> 2012.

Neupane, R.P., Sharma, K.R and Thapa, G.B. (2002). Adoption of Agroforestry in the Hills of Nepal: A Logistic Regression Analysis. *Agricultural Systems*. 12:177-196.

Ofori, C. S. 1973. The effect of ploughing and fertiliser application on yield of cassava (*Manihot esculenta* Crantz). *Ghana J. Agric. Sci.* 6: 21- 24

Ofori, C. S., Nanday, S. 1969. The effect of method of soil cultivation on yield and fertiliser response of maize grown on a forest ochrosol. *Ghana J. Agric. Sci.* 2: 19- 24

Owenya, M., Mariki, W., Stewart, A., Friedrich, T., Kienzle, J., Kassam, A., Shetto, R., Mkomwa, S. (2012). Conservation agriculture and sustainable crop intensification in Karatu district, Tanzania. *Integrated crop management*, Vol. 15 - 2012.

URT (2007). The economic survey. The Ministry of Finance and Economic Affairs Dar es Salaam, Tanzania.

URT (2011). Evaluation of the Performance and Achievements of the Agricultural Sector Development Programme (ASDP) FINAL DRAFT 12th June, 2011.

Utting-Chamorro, K. (2005). Does Fair trade make a difference? The case of small coffee producers in Nicaragua. *Development in Practice*, 15, 584-599.

Sanchez, P., Shepherd, K., Soule, M., Place, F., Buresh, R. and Izac, A. (1997). Soil fertility replenishment in Africa: an investment in natural resource capital. In: *Replenishing soil fertility in Africa: Soil Science Society of America (SSSA) Special Publication No.51: Proceedings of The*

88<sup>th</sup> Annual Meetings of the Agronomy and the SSSA, 1996, Indiana. Ed. By Buresh, R., Sanchez, P. and Calhoun, F. SSSA and American Society of Agronomy: 1-46.

Sustainet EA (2010). Technical manual for farmers and field extension service providers: farmer field school approach. Sustainable Agriculture Information Initiative, Nairobi, Kenya.

Thombiono, L. and Malo, M.(eds) (2009). Scaling up conservation agriculture in Africa: strategy and approaches. Prepared and published by FAO sub-regional office for Eastern Africa.

Thornton P. K.; Kuska, R. L.; Henninger N.; Kristjanson, P. M.; Reid, R. S.; Atieno, F.; Odero, A. N.; and Ndegwa, T. (2002). Mapping poverty and livestock in the developing world Nairobi: International Livestock Research Institute (ILRI).

Vanlauwe, B., Diels, J., Sanginga, N. and Merckx, R. (2002). Integrated plant nutrient management in sub-Saharan Africa: From Concept to Practice, CABI, Wallingford, UK.

Wangungu, C.W., Maina, M., Gathu, R.K., Mbaka, J., Kori, N. (2010). Passion fruit production in Kenya: opportunities and constraints. In: contributions of agricultural sciences towards achieving the millenium development goals: proceedings of The 3<sup>rd</sup> International E-Conference on Agricultural Biosciences, 2010. Eds. By Mwangi, M. Fact Publishing: 59-67.

#### Missing references

Ajayi *et al.* (2007

Anim-Kwapong, 2004

Appiah and Pedersen, 1998: cf.

Arwings-Kodhek (2005

Asare, 1999

Asare, 2004

ASDS, 2010

Bationo *et al.* 2007;

Bayala J, 2011

Boahen *et al.*, 2007

Boeckmann and Iolster, 2010;

Calegari, 2002

Critchley *et al.*, 1994;

De Rouw, 1995

Djarbeng and Ameyaw, 2002

ECAZ, 2001;

EPA 2003

Erenstein 2003;

Erenstein *et al.*, 2008

FAO, 2009

Fernandes *et al.*, 1981  
Fowler and Rockstrom 2001  
Franzel *et al.*, 2001  
Giller and Wilson, 1991  
Gitonga *et al.*, 2008  
ICRAF, 1998  
ICRAF, 2007  
ICRAF, 2008  
IMAG, 2001  
Juo and Lal, 1977  
Karachi *et al.*, 1991;  
Kilewe *et al.*, 1988  
Kilewe *et al.*, 1989  
Kitalyi *et al.*, 2011  
Keyser, 1996;  
Koinange, 1988  
Kwesiga and Chisumpa, 1992  
Kwesiga, 1990  
Kwesiga *et al.*, 1999  
Langmead, 2001  
Leakey, 1996;  
Mafongoya *et al.*, 2001  
Maghembe and Seyani, 1992;  
Mbwambo, 2004,  
Mwangi *et al.* (2007)  
Ngugi, 2002  
Odhiambo and Nyangito, 2002  
Oldrieve, 1989;  
Otsyina *et al.*, 2010  
Prah, 1994;  
Pye-Smith, 2010  
Reij, 2001  
Scopel *et al.*, 1998  
Sprent, 1987;  
Tursunov 2009  
Yatich *et al.*, 2007

Government of Zambia, 2009  
Nyambe and Fielburg, 2009  
Thurlow *et al.*, 2008