

Strengthening Local Agricultural Innovation Systems in Tanzania and Malawi to Adapt to the Challenges and Opportunities Arising from Climate Change and Variability

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Report prepared by:	Prof Amos Enock Majule	<i>Team Leader - IRA, UDSM, Tanzania</i>
	Dr Emma Liwenga	<i>Research Team Member - IRA, UDSM, Tanzania</i>
	Mr Lebai Nsemwa	<i>Research Team Member - ARI Uyole, Tanzania</i>
	Mr Elirehema Swai	<i>Research Team Member – ARI Hombolo, Tanzania</i>
	Mr Alphonse Katunzi	<i>Research Team Member – INADES Formation, Tz</i>
	Mr Brown Gwambene	<i>Project Research Assistant – IRA, UDSM, Tanzania</i>
	Mr Richard Lamboll	<i>Team Member & NRI coordinator – NRI, UK</i>
	Dr Tanya Stathers	<i>Research Team Member - NRI, UK</i>
	Dr Cosmo Ngongondo	<i>Team Member & NAREC Project Coordinator, Malawi</i>
	Mrs Miriam Joshua	<i>Research Team Member – NAREC, Malawi</i>
	Dr Felistus Chipungu	<i>Bvumbwe Research Agricultural Institute, Malawi</i>
	Mr Abel Chiwatakwenda	<i>Expert on CC &V – Bunda College of Agriculture</i>
	Mrs Stella Nda	<i>Research Team Member – NAREC, Malawi</i>
	Mrs Lucy Chipeta (late)	<i>Research Member, NAREC, Malawi</i>

Cover photo: Chibelela village farmer learning group members survey their sunflower learning plot – by Tanya Stathers, NRI

ABSTRACT

In many sub-Saharan African countries, poverty and food insecurity are linked to low agricultural productivity which accelerating climate change (CC) threatens to make even worse. In Tanzania and Malawi, a key challenge for decision makers is to understand the context and strategies of farmers and other stakeholders in agriculture for adapting to CC, including increasingly variable climatic conditions. Diverse farming environments and complexities associated with the context of peoples' livelihoods varying over time and space suggest a need for localised innovation to enhance and sustain productivity. There is therefore a need to foster processes for two-way communication and engagement amongst these stakeholders and for supporting their information and other needs in order to strengthen farmers' and other stakeholders' capacities to adapt.

Four years of action research in Tanzania and Malawi targeted farming communities in two contrasting agro-ecological zones per country namely high and low potential together with local, district, national, and regional. The project collectively identified information, training and products to be shared and used to develop agricultural innovation systems better able to adapt to CC and variability. A combination of a sustainable livelihoods framework and innovations systems thinking provided a conceptual frame and a learning alliance approach guided our action research. The project built on: Trans-disciplinary partnerships and initiatives in agriculture and natural resources; Tanzania's and Malawi's NAPAs (National Adaptation Programmes of Action), which prioritize agriculture; Farmers' livelihood strategies in relation to CC; and other agricultural stakeholders' (public & private) strategies. The process included distinguishing agro-ecologically and socio-economically more (Southern Highlands, Tanzania; Mzimba and Mulanje districts, Malawi) and less favoured areas (semi-arid Central Zone, Tanzania; Chikhwawa and Karonga districts, Malawi) and direct and indirect benefits to the vulnerable.

Diverse stakeholders within the agricultural innovation systems reported similar experiences and perceptions of climate change and climate variability (CC&CV) for the focal geographical locations. A participatory process was used to identify and develop the different agricultural adaptation information, training and product needs of the key stakeholders/ boundary partners (farmer learning groups, extension, stockists, media, research, NGOs, meteorological officers, National Consultation Group). The action research supported a multi-stakeholder experiential learning approach centred on village learning plots for collective planning, testing, evaluating and reflecting cycles. The action research themes included: soil and water management; crop and varietal biodiversity; and local weather data. An annual learning visit and stakeholder workshops were developed as participatory monitoring and evaluation processes, to help: share the learning amongst the different boundary partners; shape the future cycles of learning; and capture the lesson learning. An outcome mapping approach was incorporated into the learning visit to monitor and reflect on behavioural change amongst different boundary partners in relation to adaptation and supporting adaptation to CC&CV. In addition to the collective learning process, key adaptation practices identified by the agricultural innovation system actors included: deep tillage for in-situ harvesting of rain water; early maturing and drought resistant varieties and crops; new cash crops; training on community seed production; improved irrigation arrangements; CC&CV awareness raising. Farmers have begun practicing what they experimented with at the village learning plot on their own fields, and neighbouring farmers have also started testing the practices and processes. Key players in the agricultural innovation systems such as NGOs and district extension offices are already scaling out the agricultural adaptation practices and processes. Further work is needed to share the findings more widely.

Key words: agricultural adaptation to climate change, agricultural innovation systems, boundary partners, Tanzania, Malawi, in-situ rain water harvesting, crop diversification, deep tillage, action research



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1.0 Background

This action research funded by DFID and IDRC through the Climate Change Adaptation in Africa (CCAA) programme targets farming communities in contrasting sites (less and more favoured areas (agro-ecologically and socio-economically)) of Tanzania and Malawi together with local, district, national, regional and international stakeholders and identifies/accesses information to be shared and used to develop agricultural innovation systems better able to adapt to climate change and climate variability (CC&CV). A combination of a sustainable livelihoods framework and innovations systems thinking provides a conceptual frame and a learning alliance approach guides our action research. We are building on: Trans-disciplinary partnerships and initiatives in agriculture and natural resources; Tanzania's and Malawi's National Adaptation Programme of Action (NAPAs), which prioritize agriculture; Farmers' livelihood strategies in relation to CC; and other agricultural stakeholders' (public & private) strategies.

The project's contract began on the 1st April 2007 and ended in March 31, 2011. However this report also covers a three month no-cost extension. This draft final technical report presents the project's research activities, outputs and outcomes. Further details can be found in the separate project activity reports produced during the course of the project and available on the project website <http://www.ccaa-agrictama.or.tz> . The project team wishes to acknowledge the significant support from IDRC/DFID which has sustained this interesting and important research on strengthening local agricultural innovation systems to adapt to climate change.

2.0 Research problem

Climate change and climate variability (CC&CV) is a major challenge to rural livelihoods and national economies in sub-Saharan Africa, most of which are underpinned by smallholder agriculture. CC (long term) and variability (inter annual, intra annual) are among the major challenges agricultural systems in these areas are facing. There is a general consensus that climate is changing; impacting negatively and positively on different agricultural and livelihood systems. Communities, therefore need to adapt .

Diverse farming environments and complexities associated with peoples' livelihoods varying over time and space suggest a need for localised innovation to enhance and sustain productivity. Processes for two-way communication and engagement amongst these stakeholders and for improving access to information and other needs require fostering in order to strengthen farmers' and other stakeholders' capacities to adapt. There are numerous studies that show how different communities are adapting to climatic disasters. Very few of these studies have focused directly on the relationship between climate change and variability and rural livelihoods. Additionally, these studies mostly apply a single discipline approach rather than multidisciplinary/ multi-agency; have insufficient consideration of vulnerable groups within communities; and have little influence on key decision makers. In Malawi and Tanzania the key challenge is for policy makers to understand the context and strategies of farmers and other stakeholders in agriculture for coping and adapting to variable climatic conditions, in order to engender innovation. Diverse farming environments and complexities associated with peoples' livelihoods varying over time and space suggest a need for localised innovation to enhance and sustain productivity. Processes for two-way communication and engagement amongst these stakeholders and for improving access to information and other needs require fostering in order to strengthen farmers' and other stakeholders' capacities to adapt.

This action research project aimed to facilitate a process of interaction and learning whereby information/ knowledge from different sources was shared and used in effective ways by stakeholders in agricultural innovation systems to better adapt to climate change and variability. The project builds on Tanzania's and Malawi's National Adaptation Programmes of Action (NAPAs). The NAPAs prioritize agriculture in both countries as one of the sectors most vulnerable to CC&CV.

The action research intended to contribute directly to capacity strengthening primarily at the local scale, through improving the ability of participating individuals, organizations and systems to utilize knowledge more effectively, efficiently and sustainably in addressing local, national and regional priorities that will contribute to adapting to CC. The process will systematically identify and share lessons and new knowledge particularly with respect to adaptation strategies relevant to the region with key decision makers for further capacity strengthening to enhance innovation and adapt to CC in ways that benefit the most vulnerable.

3.0 Objectives of the study

3.1 Overall objective

The overall objective was to strengthen the capacity of individuals, organizations and systems within the agricultural innovation systems in less favoured areas (semi-arid Central Zone-Singida and Dodoma, Tanzania and Chikwawa/Karonga, Malawi) and more favoured areas (Southern Highlands, Tanzania and Mulanje/Mzimba Malawi) of Tanzania and Malawi to adapt to the challenges and opportunities arising from CC & V.

The individuals and organizations within the agricultural innovation systems include farmers disaggregated by gender, age, resource access, vulnerability; district councils; agricultural extension service providers, stockists; private sector companies; NGO staff; trainers; researchers; media; policy influencers and decision makers.

3.1.1 Specific objectives

Specifically, this action research project aims to:

1. Strengthen farmers' capacity to access and use quality information, training and products in order to adapt to climate change and climate variability
2. Strengthen the capacity of private and public sector stakeholders to make agricultural innovation systems work more efficiently, equitably and responsively to climate change and climate variability
3. Learn and share lessons for scaling up successful strategies for capacity strengthening (individuals, organizations and systems) within agricultural innovations systems to adapt to climate change and climate variability

The involvement of the different actors in this action research process will enhance their understanding of the resilience of each of their livelihoods in adapting to changing climatic conditions and their different knowledge sets. Their involvement will create opportunities for combined learning about and testing of adaptive strategies that could be implemented in the shorter and longer term enabling local, regional and national policy processes to be informed by practical, internally generated knowledge.

4.0 Vision and mission of the project

Both the vision and mission statements of the project remained the same and are described below.

4.1 Project Vision

“African farming communities, public and private agricultural service providers, policy makers and development partners have strengthened capacity to adapt to climate change/variability in ways that benefit vulnerable groups. The key stakeholders share experiences and knowledge on adaptive strategies in a changing climate in forums at all levels. Farmers, together with other stakeholders, are more innovative, taking advantage of the positive outcomes and overcoming the negative impacts of climate change/variability; contributing to sustainable livelihoods (food security, income and environmental management).”

4.2 Project Mission

“This project will strengthen the capacity of individual farmers, public and private agricultural service providers and policy makers to develop strategies that allow vulnerable groups to adapt to Climate Change and Variability. Working together with local communities and other stakeholders at different levels, existing and new agricultural technologies and strategies for adapting to climate change will be analyzed, evaluated and documented. Sustainable and viable innovations will be identified for a range of users and more or less favoured areas (agro-ecologically and socio-economically) in Tanzania and Malawi.

5.0 Research methodology

The action research was guided by three main frames of reference. A combination of a sustainable livelihoods framework and innovations systems thinking provided a conceptual frame and a learning alliance approach will guide our action research.

Sustainable livelihoods framework: The sustainable livelihoods framework presents the main factors that affect people’s livelihoods, and typical relationships between these (Carney, 1998, www.livelihoods.org). A sustainable livelihoods approach puts people at the centre of our conceptualization and planning and the assessment of the impact of implementation. Vulnerability was explicitly considered within the framework in terms of trends, shocks and seasonality affecting livelihood options. These was explored particularly with respect to CC & V eg shocks (drought, floods), trends (increasing incidence of crop diseases and pests), seasonality (eg predictability, rainfall duration and intensity). The approach provided a means of understanding people’s current capacity (assets or capital endowments) and how these are currently or potentially converted into livelihood outcomes, particularly adapting to climate change and variability. Structures and processes are keys to mediating people’s actual livelihood strategies. These include public and private sector organizations and formal and informal institutions. This component of the framework provides an obvious link with an Innovation Systems approach (see below).

Innovation systems concept. The Innovation Systems concept, although originating from policy debate in more industrialized countries in the 1970s and 1980s, still provided useful insights into strengthening agricultural innovation capacity in project sites. An Innovation System (IS) may be defined as a ‘network of organizations, enterprises and individuals focused on bringing new products, new processes and new forms of organization into economic use, together with the

institutions and policies that affect their behaviour and performance’ (Agricultural and Rural Development -ARD World Bank 2006). This benefited our project because the emphasis of the approach was not only on professional scientists but the totality and interaction of actors involved in innovation. This was implemented through a number of processes including farmer learning plots and individual plots. Knowledge sharing and exchange of information was shared through meetings, workshops and seminars.

Learning platforms/ Learning alliances. Complex problems such as capacity strengthening for adapting to CC & V require innovative solutions. Finding such solutions requires diverse stakeholders to engage, learn together with the ultimate aim of developing the collective commitment and capacity to turn ideas and plans into action. This can be achieved through facilitating multi-stakeholder processes and social learning. In this project we advanced the development of multi-stakeholder learning platforms at local, intermediate and national levels in each of Tanzania and Malawi based on action learning initiatives which the project partners developed (Figure 1).

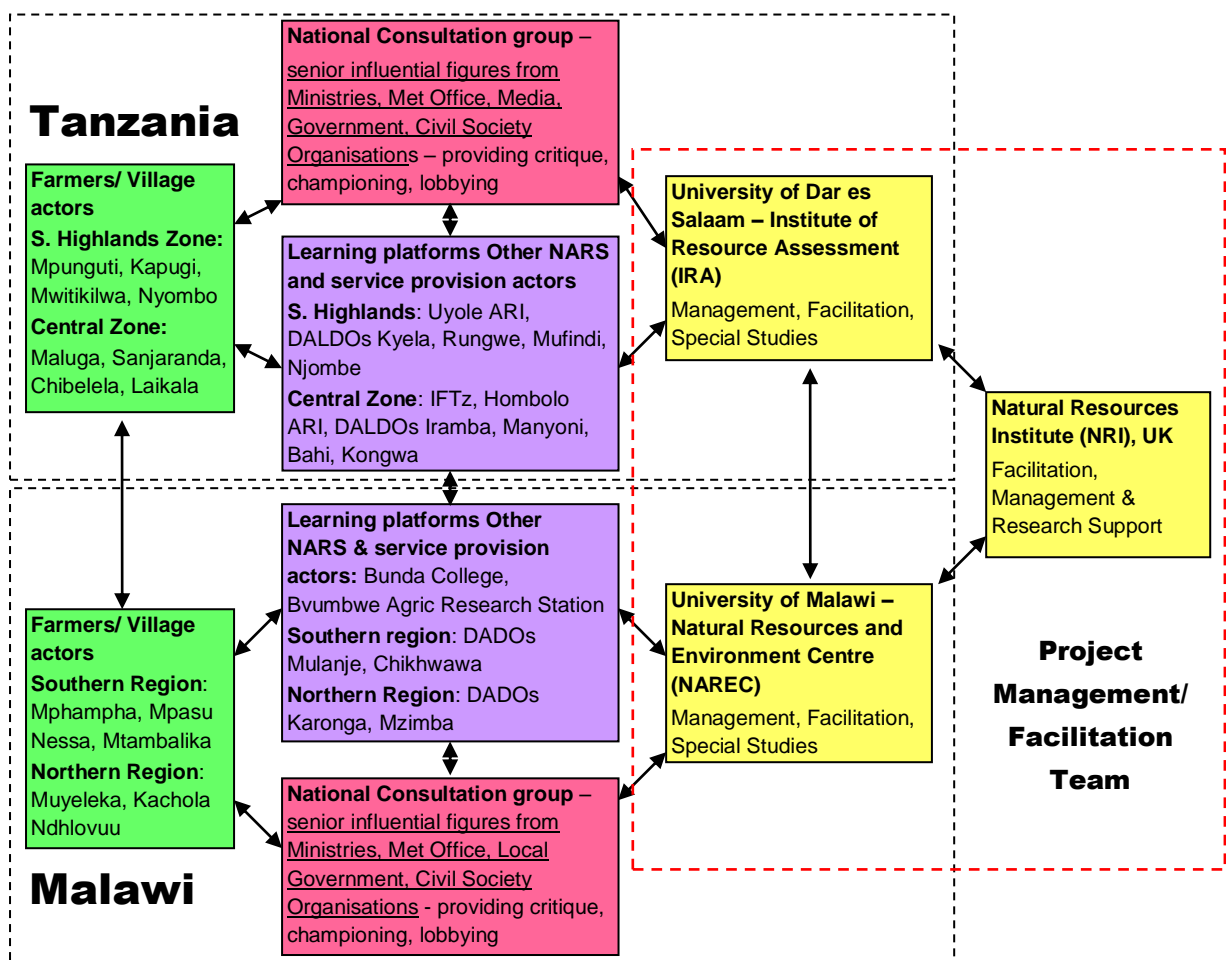


Figure 1: Key project partners and associated stakeholders

6.0 Project activities

Table 1 presents a summary of different activities achieved over a period of 4 years of the project. These activities were planned and are indicated in the project proposal document. Additional activities implemented by the project are described at the end of this table.

Table 1: A summary of different activities per objective implemented by the project

Project Specific Objectives, Outcomes, Outcome indicators, Activities and Milestones	Achievements	Yr 1		Yr 2		Yr 3		Yr 4	
		A-S	O-M	A-S	O-M	A-S	O-M	A-S	O-M
Objective 1. To strengthen farmers' capacity to access and use quality information, training and products in order to adapt to climate change and climate variability Outcome 1: Farmers and other stakeholders in agriculture better understand their own and other key actors' situations and strategies relating to CC & V <i>Outcome 1 indicator: Key actors able to clearly articulate understanding of strategies of a) target farmer categories b) other key stakeholders -Year 4.</i>									
Act 1.1 - Project inception workshop <i>by month 3, and report by month 6</i>	<p>The inception workshop was held in order to: Reach a common understanding of the project objectives and strengthen ownership with project partners; Share relevant ideas and experiences amongst project partners; Carry out detailed planning of project activities with project partners, especially for Yr 1.</p> <p>It took place in Bagamoyo, Tanzania from 11-16 June, 2007 and was attended by 19 participants (including researchers, lecturers, NGO staff, Regional Agriculture Advisors, Ministry of Agriculture staff), with visits from the CCAA programme management, the University of Dar es Salaam's IRA Director, and the Tanzanian Vice Presidents Office. Full details are given in the workshop report.</p>								
Act 1.2 - Literature review (livelihood strategies, vulnerability, climate change/ variability, innovation, service provision) <i>1st draft by month 6, final by month 12</i>	<p>In order to ensure that the project's activities were informed by the current understanding of 'climate change and variability science, projections, impacts, adaptations, adaptive capacities, livelihood strategies, vulnerability, innovation, and service provision knowledge' reviews of the global, and national and local level Tanzanian and Malawian relevant literature covering these topics were done in both Malawi and Tanzania.</p> <p>Full details are in the literature reviews, which are organised using the following sections: Introduction; Science of climate change and variability; Impact of climate change on livelihoods (with part emphasis on agriculture and vulnerability); Innovation systems; Agricultural service provision; Adaptation to climate change; Use of sustainable livelihoods approach (SLA) framework, Innovation Systems and Learning Alliances;</p>								

	<p>Recommendations for project implementation using those approaches.</p> <p>The literature reviews were initially targeted to the project team, and then adapted for use with other stakeholders such as extension and farmers, and could inform other actors in the agricultural innovation system interested in CC.</p>							
<p>Act 1.3 - Consultation with stakeholders. <i>At least 2 (1/country) stakeholder consultation surveys carried out - Yr 1. At least 4 stakeholder workshops sharing survey results, including with NCGs-Yr 1.</i></p>	<p>The objectives of the project's stakeholder consultation surveys in both Tanzania and Malawi were to: Identify key stakeholders, their roles and activities in relation to the agricultural innovation system and CC & V; Understand their current perceptions and practices regarding CC & V and adaptation; Identify patterns of interaction, including relationships; Examine enabling environments (policies, infrastructure, informal institutions, incentives); Identify individuals and organizations to work with the project e.g. in the National Consultation Group and/or as part of the Learning Alliance.</p> <p>The survey was guided by a checklist based on an agricultural innovation systems framework, and was done with a range of stakeholders from enterprise, research, intermediary, support and demand domains from February - April 2008. In Tanzania the focus was on Central and Southern Highlands Zone, and Dar es Salaam, and Arusha for input supply companies. In Malawi the focus was on Southern and Northern Zones and Lilongwe and Blantyre. A total of 74 and 83 stakeholder interviews were held in Tanzania and Malawi respectively.</p> <p>Full details are in the reports. Key issues arising were: Non-farmer stakeholders based in the regions perceptions' of CC appear broadly consistent with those of people at community level. None of the stakeholders consulted in the Southern Highlands and Central Zone and very few in Dar es Salaam were aware of the National Adaptation Programmes of Action (NAPA). Almost all stakeholders considered CC&V issues to be important or very important.</p>							
<p>Act 1.4 - Situation analysis followed by baseline survey. <i>At least 4 village-based studies per country completed and reported by trans-disciplinary teams - Month 9.</i></p>	<p>Situation analyses to explore rural peoples' knowledge, perceptions and strategies in relation to CC & CV within a broader livelihoods context was done by trans-disciplinary teams in eight less favoured and eight more favoured villages in both Malawi and Tanzania in Oct-Nov 2007. Full details are given in the reports, some key issues arising were:</p> <ul style="list-style-type: none"> • Later onset, earlier cessation, reduced amount of rainfall (particularly in less favoured areas) and less predictable rains (particularly in more favoured areas) was reported. Increased wind strength was reported in all less favoured and some more favoured areas. Some suggestion that temperatures were getting warmer. • Farmers attributed changes in climate to the local reduction in trees and other 							

	<p>vegetation or spiritual beliefs as opposed to global change.</p> <ul style="list-style-type: none"> • Agriculture is key in these communities' livelihoods and most non-farm strategies are currently linked to agriculture/natural resources. Rapid population increase and resulting land pressure suggest that non-farm activities will be crucial elements of their future livelihood strategies. • The less predictable and in many cases shorter rainy season has led to a farmer strategy of switching to faster maturing crop varieties, amongst other adaptations. • Women (particularly those who were pregnant or lactating), children, the elderly and the poor are perceived as the most vulnerable to climate changes, mainly because they are less able to leave and search for casual labouring opportunities, and additionally have fewer assets to sell/ exchange for food. 								
<p>Act 1.5 - Undertake field observations to monitor and understand climate change coping and adaptation strategies - <i>Process initiated by month 9, progress reports by month 12, 24, 36, 48</i></p>	<p>This activity was started during the situation analysis (Activity 1.4), and ongoing interaction with the farmer learning groups has deepened understanding of climate change coping and adaptation strategies (e.g. risk management through spatial and temporal agro-biodiversity management with beans in Kapugi village).</p>								
<p>Outcome 2: Information, training and product demands for strengthening climate change & variability adaptation strategies of different stakeholders identified and shared. <i>Outcome 2 indicator: Strategies for strengthening capacity in relation to climate change adaptation in place in target areas by end of month 12</i></p>									
<p>Act 2.1 – Participatory analysis of the identified coping and adaptation strategies with farmers and other stakeholders. <i>At least 4 village-based participatory assessments of farmers' demands per country completed and reported - by month 10</i></p>	<p>This activity was achieved through a number of activities. Initially coping and adaptation activities were identified following presentations during the inception workshop from Regional Agricultural and Advisors (RAA) from Iringa and Singida regions in Tanzania, and from Ms Harieth Gausi (Acting Assistant Agricultural Development Officer for Dedza district) in Malawi. Participatory identification and analysis of community level coping and adaptation strategies occurred during the situation analyses in a total of 16 villages in Tanzania and Malawi as well as during the stakeholder consultations. These strategies were shared, validated and further discussed during the National Stakeholders workshops in Tanzania (see report) and Malawi, and again in the Kigamboni, Tanzania 2008 team planning meeting (see report), and the Zonal Tanzania and Malawi annual planning meetings (see respective reports). This process continued during annual Zonal learning visits and the stakeholder learning workshops held in Tanzania and Malawi in 2010 (see respective reports).</p>								

<p>Act 2.2 – Participatory identification of info, training and products demands of different stakeholders for immediate, short and long term climate change adaptation and variability. <i>At least 4 stakeholder workshops for participatory assessment of non-farmer stakeholder demands - month 12.</i></p>	<p>Following detailed village situational analysis and consultation with non farmer stakeholders in both Tanzania and Malawi, a number of issues including information needed to strengthen adaptation capacities (eg rainfall patterns), products required (types of fertilizers, seeds etc), training needs such training on climate science others were identified for the different key stakeholders/ boundary partners. This long list was analysed by the team, choosing issues that could be implemented by the project with respect to time and budget. A list generated from the project planning meeting was then presented back to respective project villages for approval before implementation began. Issues finally agreed with communities were then implemented through learning plots. Regular participatory monitoring and evaluation of these demands occurred during the annual learning visits.</p>								
<p>Act 2.3 - Develop innovative approaches, methods and tools based on the participatory analysis and demands identified. <i>Part 2 of the activity 2.2 stakeholder workshops for participatory development of innovative approaches, methods and tools - month 12.</i></p>	<p>Development of innovative methods started during the inception workshop following presentations of Dr Paul Seward from Kenya (FIPS) and also from Dr Richard Gibson from NRI (see the inception workshop report). This process continued after situational analysis and stakeholders’ consultations. It became clear that due to the diversity of situations, strategies and assets in the different locations (8 locations per country), an approach which supported locally-specific collective experimentation was needed to ensure the outcomes were both locally meaningful and collectively understood by the different players in the agricultural innovation systems. Identification of possible action research themes (e.g. soil and water management, agro-biodiversity management, CC awareness raising, shared learning on CC adaptation) was further refined during national stakeholder consultation workshops in both Tanzania and Malawi (2008), the Kigamboni annual planning meeting, and the zonal planning meetings (Oct 2008). Some potential technologies were identified for the multi-stakeholder learning groups to test and compare with their farmers normal practices. These included: in-situ rainwater harvesting using different tillage implements (eg spring jembe, power tillers, Magoye rippers); soil fertility management practices (eg soil compost making (Mapambano), locally produced Mnjingu mazao fertiliser, farmyard manure incorporation at different application rates). Participatory video use was identified as a potential tool for providing influential voice to farmers (particularly those in vulnerable groups), and for scaling out the learning. A participatory video training course was run in Tanzania, training village extension workers and researchers, who in turn trained farmers. The stakeholder learning workshops assisted in generating and sharing further ideas.</p>								

<p>Outcome 3: Farmers' and other stakeholders capacity to adapt to climate change/ variability enhanced through improved access, understanding and decision making/ analytical skills.</p> <p>Outcome 3 indicators: Number of farmers (X% women, Y% resource poor) in 12 villages in each of 4 project sites acting on and receiving positive benefits from improved access to information, training and products on climate change adaptation according to their own indicators by end of Yr 4. Reduced vulnerability of primary beneficiaries in the longer term.</p>							
<p>Act 3.1 - Building on the activities 1.1-1.5 and 2.1-2.3 above validate approaches, methods and tools to address information, training and product demands of the different stakeholders. <i>For target groups (women, resource poor and vulnerable) at least 5 approaches validated in target districts - Year 4 for a) better informed decision making and b) enhancing ability to act on the improved understanding.</i></p>	<p>The project has been using the PAR process in selecting, implementing, monitoring and evaluating/reviewing the interventions for each specific site. The process involved multi-stakeholder participation of the local agricultural innovation system actors. These multi-stakeholder learning groups have 'learnt by doing'; collectively planning, implementing, monitoring progress or effect, reflecting and deciding whether to adopt, repeat the experiment, change some factors or conduct a new experiment) that have potential to solve the problem. The stakeholders included farmers (men, women and different well being groups), researchers, extension officers, meteorological officers, NGOs, media and stockists. These partners were involved throughout the project,. The process has been implemented through planning meetings (at village, zonal and national level), stakeholder workshops and learning visits. Before each season, all participating stakeholders have been meeting to choose and prioritize adaptation strategies based on ongoing needs assessment and their action learning. For example, farmers chose to experiment on the learning plots with different crops and crop varieties, different tillage systems and manure and fertiliser applications with the help of extension officers and researcher. Researchers and extension officers drew plot designs and assisted farmers to lay them down for easy comparisons of treatments. The learning plots were jointly assessed by all participating stakeholders, and the next seasons plans were based on their findings. The project team acted as facilitators throughout the process.</p>						
<p>Act 3.2 - Pilot successful strategies for building farmers and other stakeholders' capacity to cope with/ adapt to climate change through action research with a range of stakeholders at project sites <i>Capacity strengthening strategies for different types of farmers in groups in 12 villages</i></p>	<p><i>Some examples of the practices coming out of the multi-stakeholder learning plots are provided below.</i></p> <p><i>Malawi:</i></p> <ul style="list-style-type: none"> • Farmers view the use of combinations of organic manure and industrial fertilizers on maize production as superior in terms of grain yield compared to either of them alone particularly in times of prolonged dry spells. This could partly be attributed to the improvement of soil physical properties such as increased soil moisture retention as a result of organic manure. • Similarly, conservation agriculture involving no-till and use of herbicides (roundup & harness) in maize production has shown superior yield over traditional hand hoe 						

<p><i>at each of 2 pilot sites per country implemented years 2-4. At least 5 new service provision approaches, methods or tools used by other stakeholders - Year 4.</i></p>	<p>tillage due to improved soil moisture retention.</p> <ul style="list-style-type: none"> • Use of tie ridging has performed very well in water conservation and ensuring high yields. • In areas with limited access to irrigation water, use of sunken beds for prolonged soil moisture retention was introduced under irrigated agriculture and adoption of this technology is high due its accrued benefits such as: user friendly, high crop performance and economic use of scarce water resource available. • Crop diversification including fruits was highly appreciated. • Crops and varieties selected <ul style="list-style-type: none"> ✓ SC 403 and DKC 8033 maize varieties in Mulanje, Karonga and Chikhwawa (DK 8033 in Chikhwawa, especially under irrigation). Under rainfed, SC 403 and Pannar 67 were selected for Chikhwawa. SC 403 and Pannar 53 in Mzimba ✓ Mbundumali/manyokola cassava variety in Mulanje and Chikhwawa and Sauti (bitter variety) in Karonga. Multiplication was emphasized during this year’s growing season for sharing among farmers. Similar activity has been done for sweet potatoes. ✓ Mugamba, sweet potato variety in Mulanje; Mugamba and Salera varieties in Chikhwawa ✓ ICPL 87105 pigeon peas variety in Mulanje ✓ Chalimbana Groundnuts in Mzimba but Nsinjiro was evaluated as higher yielding (three times higher) compared to Chalimbana <p><i>Tanzania:</i> In the Southern Highlands a number of different crops and crop varieties were tested in various villages and the choice of best performers aried between villages. Among the bean varieties tested Wanja was preferred by a number of the farmers. At Mwitikilwa and Nyombo the varieties of choice are being produced on larger individual plots in the current season. The banana varieties FHIA 17 and FHIA 23 have impressed farmers by their high yields and resistance to Black Sigatoka disease at Kapugi and suckers from the Mother Plot are being uprooted and planted in individual plots. The maize varieties UH615 and UH6303 performed well at Mwitikilwa and Nyombo and farmers are looking for ways of accessing seed in future. At Kapugi the varities UHS5210 and UHS5355 gave high yields and showed good tolerance to maize streak virus disease unlike UH615 which was as susceptible as the local variety. Farmers will be on the lookout for seed as soon as the varieties are available on the market.</p>								
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	<p>In central zone of Tanzania, early and drought tolerant sorghum namely Macia and Pato varieties are being grown by individual farmers in Chibeleda, Laikala and Sanjaranda villages because of their ability to withstand adverse effects of climate change. Similarly, improved sunflower variety Record performed well across villages. Some participating villages notably Chibeleda and Laikala decided to multiply Quality Declared Seeds (QDS) of Record sunflower variety during 2010/2011 in isolated areas after having realized the advantage of this improved variety in terms of yields and oil content compared to their traditional variety which usually has notoriously low yields and low oil content. Production of sunflower QDS aimed to facilitate the majority of their farming community including the vulnerable to have access to improved seeds at affordable price. In view of high quantity of sunflower Record variety produced during the reporting period, it is expected that during 2011/2012 growing season majority of farmers within participating and non participating villages will have access to improved sunflower seed</p> <p>Furthermore, pilot areas in Central zone of Tanzania realized the importance of soil moisture conservation through a wider adoption of deep tillage methods whereby extensive increase in the use of oxen drawn tillage implements has occurred since inception of learning plots.</p>									
Objective 2. To strengthen the capacity of private and public sector stakeholders to make agricultural innovation systems work more efficiently, equitably and responsively to climate change and climate variability										
Outcome 4: Public and private sector service provision processes related to adapting to climate change/ variability assessed and implications identified.										
<i>Outcome 4 indicators: Key actors indicate qualitative change in understanding of different categories of service providers' rationale - Year 2. Increased demand by service providers for innovative learning, communication and marketing tools - Year 4.</i>										
Act 4.1 - Literature review of agricultural service provision. <i>1st draft by month 6, final by month 12</i>	This activity was combined with activity 1.2.									
Act 4.2 - Consultations with key stakeholders (to include themes such as incentives, relationships, processes) <i>Report by month 12</i>	This activity is the same as activity 1.3.									
Act 4.3 - Participatory analysis of factors e.g. incentives which will encourage innovation.	The stakeholder consultation survey discussed factors which encourage innovation, and particularly adaptation innovation such as access to up-to-date information (eg deeper understanding of CC science and adaptation options being used elsewhere), training opportunities, products including knowledge of appropriate seed varieties and									

<i>Report by month 12</i>	implements, transport, ICT equipment.								
<p>Outcome 5: Non-farmer stakeholders' capacity to adapt to climate change/ variability enhanced through improved access, understanding and decision making/ analytical skills.</p> <p><i>Outcome 5 indicators: Number of farmers (X% women, Y% resource poor) in 12 villages in each of 4 project sites acting on and receiving positive benefits from improved access to information, training and products on climate change adaptation according to their own indicators by end of Yr 4. Reduced vulnerability of primary beneficiaries in the longer term.</i></p>									
<p>Act 5.1 - Building on the activities 4.1-4.3 (in addition to 1.1-3.2) above validate approaches, methods and tools to address information, training and product demands of the different stakeholders. <i>For target groups (women, resource poor and vulnerable) at least 5 approaches validated in target districts - Year 4 for a) better informed decision making and b) enhancing ability to act on the improved understanding.</i></p>	<p>Although, the plan was for the learning plots to be multi-stakeholders in order to enhance adaptation to CC&V by all key players in the local agricultural innovation systems. However, in practice farmers, researchers, extensionists and non-governmental organization were involved in the learning plots with only occasional involvement of media, policy makers and meteorological officers. Involvement of private sector input stockists in Tanzania has not been fully exploited. In Malawi, the private sector were involved in the project's NCG and also in learning plots with particular interest in maize.</p>								
<p>Act 5.2 - Pilot successful strategies for building stakeholders' capacity to cope with/ adapt to climate change through action research with a range of stakeholders at project sites <i>Capacity strengthening strategies for different types of farmers in groups in 12 villages at each of 2 pilot sites per country implemented years 2-4. At least 5 new service provision approaches, methods or tools used by other stakeholders-Yr4.</i></p>	<p>See 3.2</p>								

Objective 3. To learn and share lessons for scaling up successful strategies for capacity strengthening (individuals, organizations and systems) within agricultural innovations systems to adapt to climate change and climate variability							
<p>Outcome 6: Impact of project activities on primary beneficiaries (eg women, resource poor and vulnerable groups) and service providers/ policy actors assessed by key stakeholders <i>Outcome 6 indicator: To be identified</i></p>							
<p>Act 6.1 – Training of key actors in participatory M&E. <i>Key actors trained in Participatory M&E - Month 6.</i></p>	<p>At the time the project started very few project team members had knowledge of PM&E. However a series of opportunities were organised to change this.</p> <ul style="list-style-type: none"> • Three key project team members namely Prof Amos Majule (team Leader), Dr Ema Liwenga, Mrs Miriam Joshua attended a PM&E training in Cairo, Egypt organised by IDRC in 2007. • Following this an outcome mapping training involving all project team members was organized place in Malawi in December 2007. This training was facilitated by Dr Alistair Sutherland from Natural Resource Institute, University of Greenwich, UK. Knowledge gained by the three team members who attended IDRC organized training in Cairo provided input to the Malawi training. • After this it was felt that more of the project partners needed to be capacitated on Outcome Mapping. IDRC approved this request and a further training was conducted in Bagamoyo, Tanzania in July 2008. • The project developed a Monitoring and Evaluation Framework document which was used by the project. 						
<p>Act 6.2 - Baseline survey using indicators identified during situation analysis and stakeholder consultation survey - <i>Report by month 9</i></p>	<p>This activity was not conducted and instead annual participatory learning visits were implemented in both countries (see learning visit reports for Tanzania and Malawi (see 2009, 2010 and part 2011 learning visit reports).</p>						
<p>Act 6.3 - Participatory M&E of capacity building strategies, involving policy influencers and decision makers. <i>Indicators refined and agreed with National Consultation Group (NCG), including possible links with NAPA resources - Month 6. M & E reports containing details</i></p>	<p>There are a number of sub activities implemented to address this activity including, formation of National Consultation Groups in Tanzania and Malawi, facilitating two meetings for them in both countries (see reports). Updating of progress against outcome mapping progress makers by boundary partners during the learning workshop in Morogoro Tanzania in 2010, and the 2011 learning visit. NCG visiting project sites in Tanzania and Malawi for example one NCG member visited Malawi site in Nessa during IDRC presidents visit to Malawi. DALDO's, TMA (in Tanzania), MEDIA and NGO's participating in learning process/visit in both countries. Visit of Regional Agricultural Advisors to project sites in Singida with project team members.</p>						

<p><i>of outcomes over previous 12 months for each of the 4years for both Malawi and Tanzania by Year1, 2,3 4</i></p>									
<p>Outcome 7: Scaling up processes for improved strategies to adapt to climate change/ variability strengthened by key stakeholders. Outcome 7 indicators: At least 5 innovative approaches, methods or tools for learning developed and implemented beyond project target sites - Year 4. Farmers in different categories aware of sustainable innovative practices for adapting to CC outside target districts - Year 4.</p>									
<p>Act 7.1 - Development of strategies for sharing the lesson learning. <i>At least 5 new methods for enhancing communication between and within target groups being implemented - Yr 4.</i></p>	<p>Strategies for sharing the lesson learning have included:</p> <ul style="list-style-type: none"> • Farmer field days at the learning plot sites • Presentations at regional and international workshops/conferences • Drama groups Chibelala, Laikala, Mpasu, Mwitikilwa, who include songs and poetry • Stakeholder learning workshops • Annual participatory learning visits, and the learning visit reports • TV and radio interviews eg Tanzania Broadcasting Corporation, Malawi Broadcasting Corporation • Participatory video • News paper articles (see policy and outreach outputs in Section 7 of this report) • Village based CC awareness seminars. • Learning plots positioning to attract curiosity on passing farmers • Involvement of key actors in the local agricultural innovation systems • Development of a Communication, Knowledge Sharing and Learning StrategyProject website, regularly updated project flyers 								
<p>Act 7.2 - Constraints and opportunities for scaling up - <i>Yr 2 onwards</i></p>	<p>Different constraints and opportunities experienced are described under the following subheadings:</p> <p>A. Constraints</p> <p>Participation: low participation of some key stakeholders: eg Public extension was missing/less committed in some villages.</p> <p>Transfers: Transfer of extension staff and political leaders in most sites across Tanzania and Malawi affects the up-scaling of best bet innovations.</p> <p>Incompatibility of expectations between some farmers and project: Based on previous experience some farmers who joined the learning plots withdrew because they expected to get free input supply for their individual plots due existing dependence syndrome. The deviants had wanted to have bigger plots for high produce to be shared amongst</p>								

	<p>them. Some farmers wanted to be paid for participating in the learning plots. Recently it seems there are projects which pay farmers for participating in their activities.</p> <p>Prolonged Dry Spells: Prolonged dry spells continued to hit some of locations such as Mphampha in Malawi contributing to the failure of other technologies.</p> <p>Long process for disbursement of funds: There was delayed disbursement of funds in year one in Malawi which resulted in delayed implementation of agreed PAR activities. Political influence on agricultural sector leads to short term thinking and adaptation to climate changes needs a longer term perspective.</p> <p>Influence of gender dynamics on selection of crops to be grown in a season: In some areas such as Chikhwawa men dominated in decision making. Most men prioritized growing of cotton with minimal attention to successful evaluated crops such as sweet potatoes and cassava which performed much better than cereals under prolonged dry spells. In Malawi, although farmers recognise the benefits of crop diversification there seems to be low uptake of other food crops. Reasons include:</p> <p>Limited markets for alternative crops: Farmers lack knowledge or information on market availability of other crops which can do well in their locality (if produced in bulk e.g. sorghum) and enhance their adaptive capacity. Local markets are not conducive because of low prices and demand.</p> <p>Dignity associated with alternative food stuffs: Maize is prioritized. Households who eat alternative food stuffs such as millet and sorghum are regarded impoverished. These alternatives are only sought after widespread famine in the localities.</p> <p>Dominant cultural orientation: food refers to maize: Although crop diversification is promoted, in practice national food security relates to maize yield which is the country's staple food. Farm input interventions like the subsidy program focus much on maize production. Although the coupons/voucher gives farmers liberty to purchase other alternative seeds of their choice responding to their agro ecological and climatic conditions, the other alternative seeds are scarce on the market. Seed companies focus on high yielding maize seeds.</p> <p>B. Opportunities:</p> <p>Transfers: The transfer exercise may provide an opportunity for scaling up of successful technologies and processes to other similar environment. For example a DADO who was transferred from Mulanje District in Malawi has started applying the knowledge gained in his new area (Thyolo District). In view of successful interventions as a result of a few</p>								
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	<p>committed members of groups there are likelihoods of having more groups' formation. District Commissioner for Rungwe District in Tanzania who was transferred to Mwanza Region has been encouraging farmers to improve water and soil conservation practices.</p> <p>Prolonged dry spells: Acted as an opportunity to identify the most promising technologies suitable for such agro-ecological conditions particularly in low potential areas, the learning plots strikingly outperformed surrounding farmers fields leading to lots of interest by other farmers</p> <p>Information sharing between stakeholders eg between extension and extension,</p> <p>Kilimo kwanza policy in Tanzania: For example provision of subsidies to communities</p> <p>Political: The opportunity is to try to find the ways to marry together the short term and long term e.g. How to combine disaster risk management and longer term climate change response (building resilience to climate change impacts).</p>									
Act 7.3 - Participatory formulation of strategies for scaling up - <i>Yr 2 onwards</i>	<p>During the learning visit, all the boundary partners were asked about who and how they were sharing the learning with, and ways in which the project could be improved. Suggestions for these strategies have at the farmer level included: having exchange visits between learning sites, holding more field days. At the extension level: using village cinema to share the learning; bring their visitors to see the learning plots; expanding the activities to cover more sites and developing more farmer learning groups; linking the learning groups to savings and credit opportunities.</p>									
Act 7.4 - Support/ encourage operationalization of strategies for scaling up - <i>Yr 2 onwards</i>	<p>Sharing of the learning has been encouraged through the learning visit reports, NCG meetings, project website and flyers, media interviews, support of baby plots at individual farmers' houses. Districts council and DALDOs, and the involved NGOs in Tanzania and Malawi are starting to use their resources to set up similar CC adaptation learning activities in other sites.</p>									
Additional activities undertaken										
Annual planning meetings	<p>Each year the project team met to discuss and plan the forthcoming seasons action research activities and other project and CC adaptation activities. These meeting are reported separately and occurred in: May 2008 (Kigamboni, Tanzania); October 2008 (Central Zone, and Southern Highlands Tanzania, and Karonga district Malawi); September 2009 (Blantyre, Malawi); September 2010 (Bagamoyo, Tanzania); June 2011 (Kibaha, Tanzania)</p>									
Annual learning visits	<p>The first CC adaptation field learning season was 2008/2009. A learning visit approach was developed in May 2009 and used each year. The aims of</p>									

	<p>the learning visit were:</p> <ol style="list-style-type: none"> 1) To share the learning associated with the learning plot activities among the project team and other stakeholders in order to: <ul style="list-style-type: none"> - share what is happening, - build on that learning to help sustain the process in the future - make sure that future planning is building on the current situation and issues - get the project team together to interact, update each other, and spend time focusing on all aspects of the project and possible future initiatives 2) To do a participatory assessment of the outcome mapping indicators with project boundary partners. <p>Separate detailed reports exist for each year's learning visit (May 2009, May/June 2010, May/June 2011).</p>								
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7.0 Project Outputs and products

This section provides an account of project outputs, which includes research reports and publications, capacity building activities, and other media policy and outreach outputs. These outputs are directly achievable products of the project's completed activities.

7.1 Research outputs

The following table lists the projects research outputs.

Table 2. Research outputs from the Strengthening local agricultural innovation systems to adapt to CC&CV in Tanzania and Malawi project

Type of output	Title of the output	Date completed
1. Workshop reports	1.1. Project inception report	Final report 2007
	1.2. Tanzania national stakeholders consultation report	Final report June 2011
	1.3. Malawi national consultation report	Final report
	1.4. Tanzania national learning stakeholders workshop	Final report
	1.5. Malawi national learning stakeholder learning report	
2. Consultation meetings	2.1. National Consultation Group meeting report Tanzania (2009)	July 2009
	2.2. National Consultation Group meeting report-Malawi (2009)	September 2009
	2.3. National Consultation Group meeting report 2-Tanzania (2010)	October 2010
	2.4. National Consultation Group meeting report 2-Malawi (2010)	September 2010
3. Research reports	3.1. Tanzania situational analysis report	Final March 2009
	3.2. Tanzania synthesis situational analysis report	Final draft June 11
	3.3. Malawi situational analysis report	Final June 2011
	3.4. Malawi synthesis situational analysis report	Final Draft June 11
	3.5. Tanzania stakeholders consultation report	Final draft June 11
	3.6. Malawi stakeholders consultation report	Final draft June 11
	3.6. Tanzania learning visit report, central zone 1	October 2009
	3.7. Tanzania learning visit report, central zone	October 2010
	3.8. Tanzania learning visit report , southern zone (2010)	October 2010
	3.9. Tanzania learning visit report, Central Zone (2011)	Draft June 2011
	3.10. Tanzania learning visit report, SH Zone (2011)	Draft July 2011
	3.11. Malawi learning visit report 1	October 2009
	3.12. Malawi learning visit report 2	October 2010
	3.13. Malawi learning visit report 3 (2011)	Draft July 2011
	3.14. Tanzania literature review report	Final June 2011
	3.15. Malawi literature review report	Final June 2011
	3.16. Swahili summary versions of situational analysis reports (for each of the 8 villages in Tanzania)	Final 2008
3.17 Tumbuka, Chichewa and English summary versions of situational analysis reports (for the 8 villages in Malawi)	Final 2008	
4. Masters dissertations	4.1 Mary A. Lema: Impacts of climate change, variability and adaptation strategies on agriculture in semi arid areas of Tanzania: The Case of Manyoni	September 2008

	District in Singida Region: University of Dar es Salaam.	
	4.2 Mongi, Hector. Vulnerability Assessment of Rainfed Agriculture to Climate Change and Variability in Semi-arid Tanzania: University of Dar es salaam.	September 2009
	4.3. Msawa Failo: Impacts of Agricultural production strategies on community livelihoods under changing climate in semi arid areas of Tanzania: The Case of Iramba District in Singida Region: University of Dar es salaam.	September 2010
5. Journal papers	5.1. Lema, M and Majule, A.E. (2009). Impacts of Climate Change, Variability and Adaptation Strategies on Agriculture in Semi Arid Areas of Tanzania: <i>The Case of Manyoni District in Singida Region, Tanzania</i> . African Journal of Environmental Science and Technology, 3(8): 206-218.	September 2009
	5.2. Mongi, H., Majule A.E and Lyimo, J. (2010). Vulnerability Assessment of Rainfed Agricultural to Climate change in Tanzania	September 2010
6.0 Chapters in workshop proceedings	6.1. Majule, A.E., Ngongondo, C., Kallanda Sabola, M., Lamboll, R., Stathers, T., Liwenga, E and O.J Ngana. (2008). Strengthening local Agricultural Innovation Systems in Less and More Favoured Areas of Tanzania and Malawi to Adapt to Climate Change and Variability: Perceptions. Impacts, vulnerability and adaptation. In Food and Energy Crisis: Contributions and challenges for Agricultural and Climate Change Research. Proceedings of the Third Annual PANTIL Research Workshop Held in Dodoma, 7-9 October, 2008. ISBN: 9987-640-29-X	October 2008
	6.2. Majule, A.E., Stathers, T., Lambol, R., Liwenga, E., Ngongondo, C., Nsemwa, L., Swai, E and Gwambene, B (2011). Exploring opportunities for enhancing capacities of individuals, institutions and political domains to adapt to climate change in agricultural sector: A case of Tanzania and Malawi. A paper presented to the AfricaAdapt Workshop held in Addis Ababa,	Forthcoming chapter in workshop proceeding 2011
7. Project fliers/posters	7.1 Project flyer developed, and translated into Swahili, Tumbuka, Chichewa as well as English	February 2008
	7.2 Updated project flyer	November 2008
	7.3 Updated project flyer	November 2010
	7.4 Updated project poster	June 2011
8. Other documents etc	8.1 Training manual on climate change and crop management, Tanzania	
	8.2 Training manual on compost making, Tanzania	
	8.2 Project Profile	
	8.3 Project Website http://www.ccaa-agriclama.or.tz	
9. Documentary video	9.1 Climate change witness (WWF), Tanzania	
	9.2 Central Zone, Singida and Dodoma climate change adaptation and training on participatory video	
	9.3 Southern Highland Zone, learning activities	

7.2. Capacity building

A total of 10 project team members were trained on Participatory Monitoring and Evaluation. This also included 6 non project members from project sites at district level in Tanzania. Different short course training as part of capacity building was also attended as indicated below;

- 480 farmers trained on CC science during village CC awareness seminars in Malawi and Tanzania
- 120 farmers trained on soil and water management techniques
- 300 farmers trained on improved agronomic practices eg row planting, spacing, weeding, use of improved seed
- 2 members attended a short course on climate risk management in Addis Ababa in 2007
- 4 members attended outcome mapping training in Egypt Cairo in 2008
- 3 project members attended a short course on climate change and gender analysis in Dakar, Senegal in 2009
- 2 project team members (Prof Amos Majule and Mr Cosmo Ngongondo) attended a one week training on participatory action research process in Nazareth, Ethiopia in
- As part of capacity building of the research team, Mr Nsemwa attended the gender mainstreaming workshop which was organised by IDRC in Kampala, Uganda in the last week of January in 2009.
- Mr Lebai Nsemwa, Elirehema Swai, Ms Tumbo Madaka, Mr Ziwa, Ms Edith Mbuu attended a one week training on participatory video in Central Tanzania, Dodoma region
- Prof Amos Majule, Mr Elirehema Swai and Mr Greno Wanda attended a one week training workshop on Improving Accessibility and Usability of Seasonal Forecast for Food Security in Africa from 8-12 March 2010.
- Prof Amos Majule and Prof James Ngana were enrolled as World Bank Institute to offer short courses training on Managing Water for Agriculture and the first training course was held in Nairobi, Kenya at AICAD center from 9-13 March, 2010. A presentation for the project is included as an attachment with this report.

A total of 3 Master students in Natural Resource Assessment and Management at the University of Dar es Salaam were trained and supervised in doing their Dissertations along the subject matter (see Table 2). In Malawi, 1 Master student is yet to complete her studies along the subject matter. At community level a total of 480 farmers who participated in the project were trained on climate change science at different occasions in 2010 and 2011 in Tanzania. This training also covered adaptation strategies particularly on soil and water management strategies including tillage.

With regards to milestones in capacity development of the teams, there has been an increased knowledge on understanding climate change issues and members are able to acquire and implement more training and climate related research. Few examples include increases capacity to teach a climate change course in particular RM 608 on climate change, receive grants to implement projects Exploring Urban-rural Interdependence and the Impacts of Climate Change in Tanzania and Malawi, Strengthened Capacity of Agricultural Sector to Adapt to Climate Change in Africa funded by Rockefeller Foundation (2011-2012) lead by a team leader, Prof Majule, another project that currently received funds from East African Community through Lake Victoria Program was as result of increased skill in writing proposals. Capacity to institutions such as IRA and NAREC has also been developing. For example hosting of large regional programs on climate change such as African Climate Change Fellowship Program (ACCFP) by IRA of the University of Dar es Salaam, capacity of NAREC and INNADES to plan and implement a projects on climate change adaptation. Regarding networking, the project has been able to strengthen new work from north (Europe) to south (Africa) and also across countries (Tanzania and Malawi). At regional level in 2009 the project established a network with other SADC countries in particular Botswana and South Africa through a grant from ICART-SADC which supported regional conference. This networking conference on climate change adaptation was in Tanzania at Kunduchi Beach Hotel in August 2009. A book will be published in 2011 as a product. This network established still exists. Networks have also been built among farming communities in learning villages. Those groups which are being formed as a result of the project

particularly in Laikalala and Ulemo villages in Tanzania are more sustainable due to their own willingness to strengthen their capacity to adapt to climate change and variability within agriculture.

7.3 Media, Policy and Outreach Outputs

The project outputs cited below cover policy and media reports and events.

Project National Consultation Groups (NCG) in Malawi and Tanzania

National Consultation Groups (NCGs) were set up in both Malawi and Tanzania as a platform for project team members to interact with national level policy makers and influencers. The role of the NCG was to promote, support and monitor the project process in an advisory capacity so that the prevailing national challenges and policies (especially at the interface between NAPA priorities and food security) were integrated and placed side by side with project goals and activities. They were also to assist the project in pushing climate change adaptation onto the political agenda, and to lobby for further funding from within and outside the country to build on the project and take forward climate change adaptation research in the agricultural/ rural sector. The NCGs were to be composed of influential figures from public and private spheres, at national and District level, whose perceptions of issues, causes, implications and solutions can play a pivotal role in public service, commercial and policy decision making. The proposed and actual composition of the Tanzanian and Malawian NCGs is shown in Tables 3 and 4.

The CCAA funded Research to Policy for Adaptation (RPA) project viewed the NCGs as novel and creative tools, which recognize how important parts of policymaking often taken part outside the formal processes. In both countries in addition to communication between the project leaders and the individual members of the NCGs, there were also two workshops organized to share project findings with and update the NCG members and for the project team to learn about what the information needs of the NCG members were regards the project and how best these could be met.

Table 3. Composition of the Tanzanian project National Consultation Group (NCG)

	Representative from	Name and contact details
1	Vice presidents office (Division of Environment)	Freddy K. Manyika, Senior Forest Officer VPO – Environment, Box 5380, Dar es Salaam Tel: 0713426060 E-mail: freddy_manyika@yahoo.com
2	Ministry of Agriculture, Food Security and Cooperatives (Food Security Department)	Mr Cleophas G. Tibanyenda, Agro meteorologist, Ministry of Agriculture, Box 9193, Dar es Salaam Tel: 0754373718 E-mail: ctibanyenda@yahoo.com
3	Tanzania Meteorological Agency (TMA)	Dr Emmanuel J. Mpeta, Meteorologist, Tanzania Meteorological Agency, Box 3056, Dar es Salaam Tel: 0784645337 E-mail: empeta@meteo.go.tz
4	Research on Poverty Alleviation (REPOA)	Ms Rehema Tukai, Research on Poverty Alleviation (REPOA), Tanzania. E-mail: rtukai@repoa.tz.org
5	Donor representative	Representative from Department for International Development
6	Political champion on environment	MP for East African Community, Hon Catherine Kamba. E-mail: katekamba@yahoo.com
7	Local NGO	Mrs Asia Kapande, Tanzania Nile Discourse Forum E-mail: asiakapande@yahoo.com
8	International NGO	Mr Dosteus Lopa, Program Manager, Care International (T), Box 289 Morogoro Tel: 0784542039 E-mail: dosteus.lope@co.care.org
9	Media community	Mr Albert Msemembo, Media, Dar es Salaam Tel: 0713 321444 E-mail: msemembo@gmail.com
10	Journalist Association of Tanzania	Ms Mari Edward, Media ITV, Dodoma Tel: 0715 677553 E-mail: wating@yahoo.co.uk

Table 4. Composition of the Malawian project National Consultation Group (NCG)

Representative from	Name and contact details
1 Environmental Affairs Department (EAD)	Mrs Shamiso Najira Environmental Affairs, P/bag 394 Lilongwe, Shamiso-b@yahoo.com 0999 895 000
2 Ministry of Agriculture and Food Security	Representative Mr Mathews Manda, Box 30291, Lilongwe 3 imprstadmin@fidpmw.org
3 Department of Climate Change and Meteorological Services	Deputy Director Mr Gray Munthali gmunthali@metmalawi.com +265999 912 643
4 Parliamentary Committee on Agriculture and Natural Resources	Chairperson Hon. Dr Allan Chiyembekeza, Box 2, Makwasa. allanchiyembekeza@yahoo.com +265888 388 277
5 Local NGO	Evangelical Association of Malawi (EAM) Mr Bryer Mlowoka, EAM, Boc 30296, Lilongwe 3 bmlowoka@yahoo.co.uk
6	CEPA Mr William Chadza, CEPA, Box 1057, Blantyre William@cepa.org.mw 0999 511 188
7 International NGO	CARE Mr Chrispin Magombo
8 Media community	Mr Nkolokosa representing Malawi Broadcasting Corporation (TV and Radio)
9 Ministry of Irrigation	Mrs Laurencia M Mzamu Irrigation Dept, Lilongwe laurenciamzamu@ymail.com 0888 797 778
10 Seed company	President of Seed Traders Association in Malawi Mr D. W. Phiri, SEEDCO Malawi, P/bag 421 LL4 dphiri@seedco.malawi.net 0999 964 424
12 Malawi Environment Endowment Trust (MEET)	Ms Karen Price MEET, Box 3053, BT Karen@naturetrust.mw 0993 742 254

Note: Representatives from DFID, Technical Committee on the Environment, Ministry of Development, Planning and Corporation, and Farmers Union have been invited to the NCG but have yet to attend.

Media and other outreach outputs

Newspaper, newsletter and website articles – in chronological order

Nyirenda, D. (2008). Research seeks solutions to climate change. *Daily Times Newspaper*, Malawi. 3 July 2008.

Nyirenda, D. (2008). Combating climate change. *Daily Times Newspaper*, Malawi. 10 July 2008. p26.

Sekeleza, K.C., (2008). Whither agriculture amidst climate change? *Nation Newspaper: Agriculture Supplement*, Malawi. 28 August 2008. p15.

Mithi, D., (2008). Changing Climate increases hardship for Africa's mothers. Women'sNet, 15 October 2008. [Quotation of projects papers presented by Ms Miriam Joshua and Dr Majule at the 2nd International Conference on Climate Change Mainstreaming organized by ANAFE, in

Lilongwe, 28 July -2 Aug 2008]. <http://www.womensnet.org.za/news/changing-climate-increases-hardship-africa%E2%80%99s-mothers>

Mithi, D., (2008). Climate Change Taxes African Women. *6th African Development Forum, ADF Today*, 20 November 2008. [Quotation of projects papers presented by Ms Miriam Joshua and Dr Majule at the 2nd International Conference on Climate Change Mainstreaming organized by ANAFE, in Lilongwe, 28 July -2 Aug 2008].

Semu Banda, P., (2008). Africa: Climate Change Imperils Livelihoods on the Zambezi River [Quotations in articles following Cosmo Ngongondo and Miriam Joshua attending the 4th Zambezi Basin-wide Strategy Consultative workshop in Lilongwe, 28-29 November, 2008]. *Goliath Business Knowledge on Demand*, Inter Press Services 26 December 2008.

http://goliath.ecnext.com/coms2/gi_0199-9850354/AFRICA-CLIMATE-CHANGE-IMPERILS-LIVELIHOODS.html

Semu Banda, P., (2009). Climate change threatens livelihoods along Zambezi basin [Article released following Cosmo Ngongondo and Miriam Joshua attending the 4th Zambezi Basin-wide Strategy Consultative workshop in Lilongwe, 28-29 November, 2008]. *The East African*, Interpress Service, 3 January, 2009, Malawi.

Semu Banda, P., (2009). Climate change threatens livelihoods along Zambezi basin [Article released following Cosmo Ngongondo and Miriam Joshua attending the 4th Zambezi Basin-wide Strategy Consultative workshop in Lilongwe, 28-29 November, 2008], *Nation Newspaper*, 3 January, 2009, Malawi.

Anon., (2009). Southern Africa: Climate Change Threatens Livelihoods. *Promoting Access to Carbon Equity (PACE): Making Carbon work for the poor Website*. Inter Press Service, 12 January 2009, <http://carbon.org.za/newsitem.php?itemid=94>

Semu Banda, P., (2009). Climate Change Threatens Livelihoods. *Global Perspectives*, January 2009, pp 29.

www.global-perspectives.info/download/2009/pdf/Expectations_Galore_January_2009.pdf

Anon., (2009). DFID, IDRC yawawezesha makulima mbinu za kukabiliana na mabadiliko ya tabia ya nchi [DFID and IDRC enhance the capacity of farmers to adapt to climate change]. *Kasuku newsletter*, February 2009, Dar es Salaam, Tanzania. ISSN 0856-7506.

Nzema, F., (2009). Tanzania and Malawi adapting to climate change. *JET Newsletter*, Tanzania, March 2009.

Mpotazingwe, M., (2010). [First NCG meeting deliberations], *Daily Times*, 13 March, 2010, Malawi.

Mpotazingwe, M., (2010). [National Stakeholder Learning Workshop deliberations], *Daily Times*, July, 2010, Malawi.

Mpotazingwe, M., (2010). Climate Change Effects Haunting Malawi [NCG meeting – Progress of CC Adaptation Rural Project and Introduction of Urban Rural Project], *Daily Times*, 30 November, 2010, Malawi.

Mpotazingwe, M., (2011). [IDRC President David Malone’s Visit to a CCAA Project in Malawi]. *Daily Times*, 10 and 27 January 2011

Kanjo, M., (2011). Mulanje Flood Victims Receive Agricultural Assistance [Distribution of farm inputs and implements to Ness flood victims from IDRC], *Nation Newspaper*, 30 May, 2011, Malawi.

Radio and TV coverage - in chronological order

March 2008. News Bulletin, *Malawi Broadcasting Radio* 2. Noon and 6pm, 11 March 2008

February 2010. CCAA programme management visit to Malawi- Dr Fatima Denton and Dr Evans Kituyi visit to Chikhwawa and Mulanje study sites New Item. *Malawi News*, 12 February 2010.

February 2010. CCAA programme management – Dr Fatima Denton and Dr Evans Kituyi visit to Chikhwawa and Mulanje study sites News Item. *Malawi Broad Casting Television News and News outlook*. Aired more than 6 times between 12 February 2010 - 5 March 2010.

February 2010. NAREC role in implementation of climate change and adaptation project under CCAA programme. Interview with Miriam Joshua on News Outlook. *Malawi Broadcasting Corporation Television*.

March 2010. First NCG meeting deliberations. *Malawi Broadcasting Corporation Television News*, 13 March 2010.

March 2010. Distribution of Treadle Pumps in Chikhwawa district. *Malawi Broadcasting Corporation Television News*, 15 March 2010.

March and May, 2010. Field visits to Chikwawa and Mulanje sites and field day outcomes. *Malawi Broadcasting Corporation Television News – News bulletin*.

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8.0 Project outcomes

Our project had seven main anticipated outcomes (see Project Schedule in section 6). The first part of this section is organized according to these outcomes and their associated objectives. The second part sets out outcomes (consequences) in terms of changes in scientific knowledge or innovation; changes in behaviour of boundary partners; policy influence, technology development, adaptation and adoption and finally any changes in socio-economic or environmental conditions.

8.1. Achievements against the project's anticipated seven outcomes

Objective 1. To strengthen farmers' capacity to access and use quality information, training and products in order to adapt to climate change and climate variability

i) Improving farmers and other stakeholders in agriculture understanding of their own and other key actors' situations and strategies relating to CC & V

Interventions aiming to strengthen farmers' capacity are more likely to succeed if key decision makers understand farmers and other AIS actors' situations and strategies. We used a Learning Alliance approach (see Figure 1) aiming to improve the awareness and understanding of our boundary partners by creating platforms and opportunities for interaction, experiential and shared learning at various levels (community, sub-national, national, inter-country). Examples of the main structured activities facilitating interaction between boundary partners are shown in Table 11. Our main sources of information to assess changes in understanding are Learning Visit reports and Workshop reports.

Small-scale farmers – farmers in the project's learning groups appear to have a more conscious understanding of their own strategies relating to CC and CV. This has been through farmers brainstorming and sharing their experiences of and strategies for adapting to CC and CV in Situation Analysis and subsequent fora and exchange of information between farmers from the different project sites in the 2008 and 2010 stakeholder workshops, and through the showing of Participatory Video clips. Other farmers in the same villages and in other villages in the same districts are copying from learning group farmers' activities and results.

In Tanzania, Farmer Learning Group (FLG) members have a better understanding of researchers' strategies for adapting to CC and CV. In semi-arid Central Zone, farmers learnt how to lay out experimental plots and participated in researcher-farmer designed experiments on: soil and water management (eg manure application, tillage), agronomic practices (eg spacing, thinning); short duration drought tolerant varieties of sorghum, maize, sunflower and sweet potato (including orange fleshed) and a new crop lablab bean. In the higher rainfall Southern Highlands Zone Tanzania (SH Tz), farmers learnt how to lay out experimental plots and participated in researcher-farmer designed experiments to improve farmers access to and management of agrobiodiversity. Crops and varieties varied with agro-ecology both between and within villages and included: disease resistant varieties (eg maize, beans, banana, wheat) and new crops (eg avocado, banana) due to perceived increased temperature in recent years and water melon, soya and onions in response to market opportunities. In Central Zone, farmers have learnt about Quality Declared Seed (QDS) seed which involves training on the principles of seed production in order to produce seed intended for sale to neighbouring farmers. Also in Central Zone, the Manyoni district extension service is aiming to improve farmers access to seasonal forecasts through disseminating information at ward/ village and sub-village level eg on notice boards and through church groups and village assembly meetings.

In Malawi, FLG members have a better understanding of researchers' strategies for adapting to CC and CV. These include soil and water management techniques (eg sunken beds, no till and use of herbicides, tie ridging), mapambano compost manure from INADES Tz and originally from farmers in Kondoa district, Central Zone Tz; improved irrigation techniques on vegetables and maize; early maturing, high yielding maize varieties from research and seed companies; early maturing pigeon pea, high yielding and early maturing sorghum, sweet potato (including orange fleshed), beans & groundnuts, early maturing and disease free cassava, grafting of fruit trees; FLG members have stated the importance of working with a multi-stakeholder group (eg NGOs, researchers, extension) in order to adapt to climate change.

Public extension - extension officers are generally able to articulate an understanding of recommended technologies being used by FLGs and their link with CC and CV. However, we don't yet have information from extension officers on how they assess their changed understanding of farmers' own local/ indigenous strategies. Some extension officers have replicated the learning plot approach elsewhere while others have disseminated technologies to other farmers within and outside their districts. Many district level HQ staff have been transferred making participatory assessment of change with individuals and continuity challenging. However, most village level staff are still in place.

NGOs- The understanding gained of other actors' situation and strategies has created opportunities for some NGOs working with the project to replicate the learning plot approach in some cases and promote the technologies with other farmers. For example, Sanjaranda Bible College (Central Tanzania) has sourced money from IAS, and EAM of Malawi has support from the Irish government. In the case of INADES TZ, CC knowledge acquired has added value to existing knowledge of farmers context and strategies. INADES has subsequently participated in and contributed to a range of CC related activities at local, national and regional levels. FIPS AFRICA's understanding of farmer context and strategies has contributed to the development of their Irish aid project in Central Zone of Tanzania.

Stockists - In Malawi the STAM representative (from the company SEEDCO is on the NCG). Following participation in NCG meetings and stakeholder meetings SEEDCO has donated short duration maize hybrid seed for experiments on learning plots in Malawi. Small scale stockists sold seed and fertilizer commercially for learning plots in Southern Highlands, but otherwise stockists have not participated in the project since the consultation survey in Tanzania. Krishna Company (based in Manyara region) sold seed at a subsidized price. Minjingu Company in Arusha provided Minjingu mazao fertilizer (manufactured in Arusha) for learning plots in Central Zone in the first year.

Researchers -Researchers in the project team are better able to articulate and have secured further projects through improved knowledge of other stakeholders' situation and strategies regarding CC and CV. Projects include: the 'Exploring Urban-Rural interdependence and the impact of climate change in Tanzania and Malawi' CCAA Urban programme funded project, a SADC funded project on Strengthening local agricultural innovations to adapt to climate change through networking in Tanzania, Botswana and Malawi, Rockerfeller project on Strengthening Capacity of Agriculture Sector to Adapt to Climate Change Impacts in Africa, East African Community Lake Victoria Environmental Programme supporting a project on "Improving Agricultural Productivity in Response to Climate Change by Introduction of Alternative Crops and Innovative Technologies suitable for the Lake Victoria Basin". In some cases, climate change knowledge acquired has added value to existing knowledge of farmers context and strategies. Researchers have played the role of stockists in some cases, particularly for non-maize crops. Researchers made available some pre-release material which they thought would do well in a particular locality.

Media – In Malawi, the TVM climate change desk officer has been to the project field sites four times which created an opportunity to improve their understanding of farmers and researchers’ situation and strategies (eg two interviews with the Malawi project leader incorporated into TV programmes). In Tanzania, a visit by a journalist to Chibelela village, Central Zone led to an article on the importance of the spring jembe (deep tillage) in Nipashe newspaper. Information provided by the project leader to BBC London on CC in Tanzania contributed to a report on Climate Change produced by the BBC. The project leader shared information through interviews with TBC radio and TV on CC day.

Met office – in Malawi the project facilitated visits by the Met office to districts and villages and the Met Office has provided seminars on CC to FLGs in all participating villages. The Met office has recognized the need to make information available at local level in local languages and the need to get feedback from users. In Tanzania, the project facilitated training by the Met office to farmers in workshops and weather stations were established in all 8 villages in Tanzania following met office advice. The Met Office is now interested and willing to use the weather data collected by the FLGs. In Central Zone, the Laikala VAEO takes data from FLG met station to district HQ, data is entered on a met office form. The station is not yet registered with the Met Office, but efforts are underway to register all the FLG/ village met stations with Tanzania Met Authority (TMA).

ii) Identification and sharing of information, training and product demands for strengthening CC & CV adaptation strategies of different farmers

Information, training and product demands for different boundary partners were identified. Tables 5a-5b summarise the information, training and product demands and ideas for how to respond to them in order to strengthen CC & CV adaptation strategies of farmers, district extension and NGOs in the central and S. Highlands of Tanzania. These were identified through the Situation Analysis and Stakeholder consultation survey, further developed and shared in the national stakeholder workshop and then converted into themes in the Kigamboni planning workshop mainly by the project team in 2008. The themes were further refined in zonal meetings in Tanzania and Malawi. The outcomes are summarised in Table 6a and b below. A large number of needs and challenges were identified and these were then reduced to a smaller number of planned action research themes. Ultimately, however, the action research focused on the Farmer Learning Groups working primarily with Ministry researchers and district extensionists. The implemented research themes in Tanzania were: Improved access to climate and weather information and policy (CZ and SH); Improved soil and water management (CZ); Improving access to and management of crop varieties (CZ); Improved access to and management of agro-biodiversity (SH). In Malawi themes were very similar: Improved access to climate and weather information and policy; Crop and livelihood diversification; and Improved soil and water management.

Table 5. Summary of boundary partners' needs and emerging action research themes to strengthen capacity to adapt to CC and V.

a) Tanzania

Needs identified	Planned action research themes	Implemented action research
<p>Farmers</p> <ul style="list-style-type: none"> – Soil fertility and soil water management – Access to appropriate and local language agricultural related information – climate, weather and markets – Promote local ownership of land use planning – Access to affordable credit facilities – Awareness on CC – Appropriate inputs – Oxen implements – Entrepreneurship skills – Access to markets – Household food security – storage 	<ul style="list-style-type: none"> – Improved access to climate and weather information and policy (CZ and SH) – Improved soil and water management (CZ) – Improving access to and management of crop varieties (CZ) – Improving access to and management of agro-biodiversity (SH) 	<ul style="list-style-type: none"> – Improved access to climate and weather information and policy (CZ and SH) – Improved soil and water management (CZ) – Improving access to and management of crop varieties (CZ) – Improving access to and management of agro-biodiversity (SH)
<p>District Extension</p> <ul style="list-style-type: none"> – Soil water conservation – Information and markets – Understanding of CC issues 	<ul style="list-style-type: none"> – Soil and Water management capacity to adapt to climate change and variability (SH) – Increased access and capacity to interpret scientific and indigenous meteorological data (CZ) 	
<p>NGOs</p> <ul style="list-style-type: none"> – CC capacity building 	<ul style="list-style-type: none"> – Improving livelihood diversification options through enhancing access to market and entrepreneurship skills information (SH) – Identification of successful adaptation initiatives to CC & CV, validation and promotion of these with other stakeholders (CZ) 	
<p>Stockists</p> <ul style="list-style-type: none"> – Understanding of CC issues – Understanding and first hand experience of the impacts of CC on crop choice and management in order to provide relevant products and information in time and space in response to CC&V challenges and opportunities. 	<ul style="list-style-type: none"> – Appropriate input, type and pack size (SH) – Meeting appropriate input demands (CZ) 	
<p>Researchers</p> <ul style="list-style-type: none"> – Understanding of action research – Understanding of impacts of CC on farmers in different agro-ecological zones – Awareness of CC adaptation strategies being practiced elsewhere – Awareness of climatic projections for different agro-ecological zones 	<ul style="list-style-type: none"> – Adequate research capacity to respond to research demands on CC&V related to agricultural innovation systems 	
<p>NCG</p> <ul style="list-style-type: none"> – Understanding of impacts of CC on farmers and other stakeholders – Understanding of farmers and others stakeholders strategies for adapting to CC&CV – First hand experience of the multi-stakeholder learning happening in the project sites in relation to CC&CV adaptation 	<ul style="list-style-type: none"> – Being a corridor for grass roots information and experiences in adapting to CC & CV to reach policy makers 	
<p>Met Office</p> <ul style="list-style-type: none"> – Understanding of farmers and other stakeholders needs regards weather information and projections 	<ul style="list-style-type: none"> – <i>No theme originally identified</i> 	

b) Malawi

Needs identified	Planned action research themes	Implemented action research
<p>Farmers</p> <ul style="list-style-type: none"> – Soil and soil water management (irrigation, ridging) – Access to appropriate and local language agricultural related information – climate, weather and markets – Promote local ownership of land use planning – Awareness on CC&V – Appropriate agricultural inputs – Entrepreneurship skills – Access to markets – Household food security – storage 	<ul style="list-style-type: none"> – Crop and livelihood diversification How to select proper crops to improve household food security and income in a changing climate 	<ul style="list-style-type: none"> – Crop and livelihood diversification – Improved soil and water management – Improved access to climate and weather information and policy
<p>District Extension</p> <ul style="list-style-type: none"> – Soil water conservation – Information and markets – Understanding of CC issues – Crop varieties and types – Tree crops – Manure making 	<ul style="list-style-type: none"> – Crop and livelihood diversification: How to select proper crops to improve household food security and income in a changing climate 	
<p>NGOs</p> <ul style="list-style-type: none"> – CC & V capacity building – Planning of action research – Disseminating climate information 	<ul style="list-style-type: none"> – Crop diversification and natural resources management: How will natural resource management contribute to crop productivity in a changing climate 	
<p>Stockists</p> <ul style="list-style-type: none"> – Understanding of CC issues – Understanding and first hand experience of the impacts of CC on crop choice and management in order to provide relevant products and information in time and space in response to CC&V challenges and opportunities. 	<ul style="list-style-type: none"> – Development of cultivars suitable in a varying climate. – Provision of suitable planting materials. – How to improve stockists capacity to response to farmers needs and liase with suppliers and research institutions in improving adaptive capacity to challenge 	
<p>Researchers</p> <ul style="list-style-type: none"> – Understanding of action research – Understanding of impacts of CC on farmers in different agro-ecological zones – Awareness of CC adaptation strategies being practiced elsewhere – Awareness of climatic projections for different agro-ecological zones 	<ul style="list-style-type: none"> – Development of cultivars suitable in a varying climate – Provision of suitable planting materials. – How will agricultural research contribute to crop productivity in a changing climate 	
<p>NCG</p> <ul style="list-style-type: none"> – Development of cultivars suitable in a varying climate – Understanding of impacts of CC on farmers and other stakeholders – Understanding of farmers and others stakeholders strategies for adapting to CC&CV – First hand experience of the multi-stakeholder learning happening in the project sites in relation to CC&CV adaptation 	<ul style="list-style-type: none"> – No theme originally identified 	
<p>Met Office</p> <ul style="list-style-type: none"> – Understanding of farmers & other stakeholders needs regards weather information & projections 	<ul style="list-style-type: none"> – No theme originally identified 	

Table 6a. Central Zone and S. Highlands Tanzania: FARMERS Information Training and Product Needs and how to respond to them

Theme	Details
Soil fertility and soil water management	<ul style="list-style-type: none"> – Current impact of existing technologies on soil water conservation and soil fertility CZ. SH – Training on soil water management CZ – Understanding visual symptoms of nutrient deficiency in key crops CZ – Training modules CZ – Take home appropriate reference material CZ – Leaflet eg maize doctor, sorghum doctor CZ – Information on types, pack sizes, impacts of fertilizers SH – Soil and water/soil fertility conservation practices – Good agricultural husbandry practices SH
Access to appropriate and local language agricultural related information	<ul style="list-style-type: none"> – Weather data CZ – Market information (price, quality, demand) CZ SH – Adaptation and coping strategies to CC & CV CZ – CC & CV subject issues CZ – Exchange visits between farmers facing similar CC issues CZ SH – Training on <u>systematic</u> weather data recording CZ SH – Rain gauges CZ – Information materials CZ
Promote local ownership of land use planning	<ul style="list-style-type: none"> – Village land act and by-laws flyer (Swahili) CZ SH – Undertake participatory land use planning CZ SH – Training on current land reform act 1999 and land title deeds CZ SH
Access to affordable credit facilities	<ul style="list-style-type: none"> – Information on available local credit schemes CZ SH – Lending mechanisms and procedures CZ SH – Micro-finance and cooperative policy CZ SH – Linking to training institution. CZ SH.
Awareness on CC	<ul style="list-style-type: none"> – Identify existing local knowledge and scientific on climate issues. CZ SH – Dissemination of current status on climate change CZ SH – Training on current scientific knowledge on CC CZ – Training on understanding and use of met forecast data CZ – Training on climate data (weather data) collection and interpretation SH – Analysed information on hydro met CZ – Adaptation and coping strategies to CC & CV SH – CC & CV subject issues SH – Awareness on National Adaptation Programme of Action SH – Increase awareness on climate change: Causes and impacts –more focus on adaptation SH – Linking scientific knowledge with -traditional knowledge on weather prediction/forecast SH
Appropriate inputs	<ul style="list-style-type: none"> – Location and details about the QDS trained farmers CZ SH – Training on community seed production (quality, isolation distance, storage) CZ SH – Training on participatory variety/ crop evaluation (ensure FFS experimentation/ analysis skills strengthened) – Mini packs of inputs to enable farmers to test CZ – Facilitate enforced quality control of agricultural inputs CZ – Knowledge on improved seeds SH – Improved seeds SH
Oxen implements	<ul style="list-style-type: none"> – Understanding of why different tillage implements are appropriate CZ SH – Fabrication designs e.g. yokes for ploughing and weeding CZ SH – Farmer to farmer training on use of ox drawn implements CZ SH
Entrepreneurship skills	<ul style="list-style-type: none"> – Product/ market demand CZ SH – Sensitisation on difference between subsistence and entrepreneurial activities CZ SH – Business skills CZ SH – Partial budget/ cost benefit analysis CZ SH
Access to markets	<ul style="list-style-type: none"> – Information on acceptable quality standards and processes CZ SH – Current commodity price CZ SH – Training on value adding opportunities and standards for sunflower, sorghum etc CZ SH
Household food security	<ul style="list-style-type: none"> – Training on improved crop storage to help survive low yields in bad year CZ SH – Traditional and synthetic post-harvest protectants CZ

	– Pesticide safety, use and management SH
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CZ = Central Zone; SH = S. Highlands

Table 6b. Central Zone and S. Highlands Tanzania: DISTRICT EXTENSION WORKERS Information Training and Product Needs and how to respond to them

Theme	Details
Soil water conservation	<ul style="list-style-type: none"> – Current impact of existing technologies on soil water conservation and soil fertility CZ – Training on construction of contours CZ – Training on design of charco dams CZ – Training materials (eg vertical intervals etc for contour) CZ – Training materials on soil water conservation (eg use of pits CZ)
Information and markets	<ul style="list-style-type: none"> – Village information centre SH – Training on how to improve farmer's access to market information SH
Understanding of CC issues	<ul style="list-style-type: none"> – Relevant climate information and weather prediction CZ – Training on appropriate measures for CC & CV CZ – Installation of rain gauges CZ – Relevant climate information and weather prediction SH – Identification of appropriate information with regard to climate change and variability; SH <ul style="list-style-type: none"> • For example; suitable land use practices • Water harvesting technologies • Environmental conservation – Research information specific to the localities SH – Entrepreneurship and value addition of agricultural products to enhance the competitiveness in the market SH – Provide appropriate agricultural input /knowledge in line with climate change and variability.SH – Training on appropriate measures for CC & CV SH – Adaptation to climate change and variability SH – Onset and end of rain season (linking of traditional and scientific knowledge)SH

CZ = Central Zone; SH = S. Highlands

Table 6c: Central Zone and S. Highlands Tanzania: NGOs' Information Training and Product Needs and how to respond to them

Theme	Details
CC capacity building	<ul style="list-style-type: none"> – Information on adaptation to CC & CV CZ – Information on NAPA CZ – Impact of agricultural technologies on environment CZ – Lack of forum for info exchange between stakeholders CZ – Identify case studies on successful adaptation to CC & CV CZ – Early warning systems to help farmers prepare CZ – Gendered perspective on CC CZ – Training on CC CZ SH – Training on Advocacy CZ SH – Training on Communications CZ SH – Scientific details on effect of CC & V on livelihoods CZ SH – Improved infrastructure & input supplies and sharing research CZ – Alternative energy, solar, wind power CZ – Leaflets, guides CZ – Website on CC CZ – Linkage of local innovation with researchers to help objectively assess performance of different technologies for helping adapt to CC & CV CZ – Documents on CC, NAPA, global perspectives CZ – Climate change and means for adapting SH – Appropriate utilization of water resources SH – Water harvesting technologies SH – Preparation and use of organic manure SH

CZ = Central Zone; SH = S. Highlands

iii) Enhancing farmers capacity to adapt to climate change/variability through improved access, understanding and decision making/ analytical skills.

The project Situation Analyses identified farmers' perceptions of factors influencing their ability to adapt. These were both internal (ie individual, household or community strengths or assets) and external factors eg policies. Based on these factors an assessment may be made of how the project has contributed to strengthening farmers' adaptive capacity (see also Appendix 1).

Internal factors contributing to farmers' adaptive capacity which have been addressed include:

- *Crop diversity.* Farmers in the FLGs have access to a wider range of new crops and varieties and some of these are starting to become available beyond the FLGs
- *Crop resilience (in terms of weather conditions).* FLGs experimented with crops and varieties which offered more options for dealing with local weather conditions. The attributes needed varied with location but included: drought tolerance, longer and shorter maturity periods, disease tolerance (often associated with weather conditions), yield, suitability for markets.
- *Access and ability to keep livestock.* Livestock can act as a buffer against shorter term shocks and stress if they can sold to secure income. Although the project didn't deal directly with livestock, the Kapugi group accessed pigs from the Rungwe DALDO office because they were regarded as a well organized group.
- *Ability to store food.* The project has focused heavily on the field stage of crops as opposed to the post-harvest stages. However, use of new varieties resulted in the need for different crop storage practices eg improved varieties of sorghum suffered higher damage during storage than traditional varieties and thus required additional grain protection interventions. However no explicit focus on experiential learning regards different storage methods occurred, nor did any analysis of the farmer learning group member's ability to store food. This is an important future opportunity.
- *Financial capital.* The project didn't deal directly with financial capital issues, although it was a re-occurring theme during Learning Visits etc. An example of indirectly accessing finance was the Nyombo group in the SHTz who acquired a power tiller on a shared cost basis from the Njombe DALDO's office. The sister CCAA Urban-Rural linkages is starting to explore the relationship between accessing credit and adaptive capacity/ resilience. One option we explored in the first year was making seed available in small more affordable packs to try and address the issue of limited capital. This should be follow up in the future.
- *Natural capital.* The diversity of natural capital in a given location can make a significant contribution to adaptive capacity. For example in Kapugi village in S H Tz farmers are able to produce beans in three different seasons making use of both lowland valleys and uplands within their villages. In Malawi, access to land for dimba farming was mentioned as a strength. The project identified the need to improve farmers' knowledge of land law, rights and responsibilities but it was beyond our resources to address these issues during the current project. Improved soil management (compost, manure, fertilizer experimentation) and water management allows farmers to make more sustainable use of natural capital.
- *Human capital.* Farmers in the FLGs have acquired various new knowledge and skills. These include: better understanding of weather, knowledge of managing (new) crops and ability to experiment and to adjust cropping practices and mixtures in relation to the season eg rain onset time or seasonal projections. Human capital – education and experience from elsewhere, the project has strengthened farmers understanding of CC science and adaptation strategies being used by other groups, including how to experiment in order to learn about alternative strategies of potential use in a changing environment. Farmers and researchers have shared CC adaptation experience from elsewhere.
- *Social capital.* FLG members have benefitted through interaction within the group and other actors (see Table 11 showing interactions between stakeholders).
- *Non-farm livelihoods* were viewed as a strength – but we didn't really explore this in this project.

External factors (including policies) influencing farmer's ability to adapt includes:

Strengthening factors

- *Government policies.* The Situation Analysis identified some policies contributing towards strengthening farmers' capacity. These included: policies encouraging farmers to diversify crops, grow drought resistant crops/ varieties and plant trees. In Malawi, some farmers reported that the subsidy programme was a strengthening government policy. Farmers' demands and government policy are in harmony with respect to crop diversification and tree planting. However, actual support for crop diversification is relatively limited compared to support in the form of subsidies for maize in both countries. See policies section below for further discussion.
- *Financial capital.* In the Situation Analysis some farmers reported that government policy supporting the creation of savings and credit groups (eg SACCOs) was improving farmers' access to credit. However, setting up such a group is beyond many farmers and alternative forms of credit (eg Vikoba village community banks for internal savings and lending) appear to offer opportunities to a wider range of farmers.
- *Access to service providers* – training in use of early maturing seed etc, the project has supported three years of multi-stakeholder learning processes to develop novel ways for stakeholders to interact, and better understand each others knowledge sets and the opportunities for combining them.
- *Technology.* Technology can play a key role in increasing adaptive capacity. Farmers provided the example of mobile phones which can, for example, reduce the need for and costs of travel.

Weakening factors

- *Government policies.* Some policies were perceived by farmers to be weakening their capacity. Two examples cited were free market approaches increasing the costs of inputs (SH Tz) and education for all children putting extra pressure on household food security (Central Zone Tz). Another example described in Malawi was that of national parks taking all their fertile land and leaving them with depleted fields (Chikwawa district).
- *Natural resource conflict.* Conflict over land, water etc can be a major source of vulnerability. An example given was neighbouring villagers allowing their cattle to feed on another village's pasture. The impact of climate change, climate change responses (eg use of biofuels) and increasing population pressure increase the likelihood of future conflict.
- *Corruption.* Farmers made the point that corruption weakens their capacity to adapt. An example given during a women's focal group discussion was the need to pay bribes in order to access credit eg Kikwete funds.
- *Poor service provision.* In Malawi farmers explained that late distribution of the subsidy coupons and lack of access to inputs (due to their high cost and lack of credit opportunities) weakened their capacity.
- *Market uncertainty.* Fluctuations in market prices, input costs, and lack of market outlet opportunities all weaken their adaptive capacity.

During the September 2010 NCG meeting a senior Tanzanian Ministry of Agriculture representative emphasized that government policy is intended to be 'bottom up'. This implies that initiatives are needed which strengthen the voice of local actors at village, ward and district levels. Participatory video has provided one new means of strengthening the voice of local actors, particularly at community level.

Objective 2. To strengthen the capacity of private and public sector stakeholders to make agricultural innovation systems work more efficiently, equitably and responsively to climate change and climate variability

iv) Assessment of public and private sector service provision processes related to adapting to climate change/ variability

The Stakeholder consultation surveys identified that most Agricultural Innovation System (AIS) stakeholders considered climate change and climate variability to be important or very important. However, almost no stakeholders consulted were aware of their respective country's NAPAs, let alone its content. At the individual level, very few of the stakeholders consulted had much knowledge of climate change issues, but frequently expressed a desire to improve their understanding. Stakeholders' information, training and product needs were identified (see Table 7 below for Tanzania)

Table 7: Tanzanian AIS stakeholders. Information, training and products which would enhance their capacity to adapt to CC&V?

Mbeya	Iringa	Dodoma	Singida	National
Information on				
<ul style="list-style-type: none"> – Sensitization on climate change and variability, – Weather forecasting, – Relevant CC&V info, farming practices and weather prediction information through media eg radio, phone, newspapers 	<ul style="list-style-type: none"> – Relevant climate, weather prediction information 	<ul style="list-style-type: none"> – On adaptation to CC&CV, NAPA, improved agricultural production and marketing (Trade Fairs) – Relevant Climate weather prediction information, – Strengthen network, a network with other related research institutes in the central zones and Extension Liaison Unit (ZIELU), Crop breeders, socio economists, crop processors. – Information on suitable crops for the area, market information in the region and outside 	<ul style="list-style-type: none"> – how others managed to adapt to CC&V – Relevant Climate weather prediction information – Improved agricultural livestock production and environmental conservation to help in adaptation to CC&V 	<ul style="list-style-type: none"> – Information: On the effect of climate change on wildlife. – Development of website for information sharing – Network for information sharing – Relevant Climate, weather prediction information – Market information
Training				
<ul style="list-style-type: none"> – Appropriate measures for CC&V, environmental issues and economic activities – Appropriate use of agricultural inputs measures for CC&V – Appropriate measures for CC&V and agricultural production – Appropriate measures for CC&V and data management 	<ul style="list-style-type: none"> – Training on appropriate measures for climate change and variability – Training on entrepreneurship, good agricultural practices, gender and development 	<ul style="list-style-type: none"> – Climate change, advocacy, communications, improved agriculture and appropriate measures for CC&V – Training manpower, staff training (Capacity in TOT). Involved in training on appropriate measures for CC&V – Training on manpower, staff in general, administration, accountancy, and marketing and on appropriate measures for adaptation to CC&V. 	<ul style="list-style-type: none"> – Training on improved agriculture and appropriate measures for CC&V – Training on appropriate measures for CC&V – Training on appropriate measures for CC&V and type of crops to be grown. – Training on appropriate measures for CC&V and entrepreneurship. 	<ul style="list-style-type: none"> – Involved in Training on CC&V – Training persons on appropriate measures for CC&V – Integration of adaptation measures in development plans
Products				
<ul style="list-style-type: none"> – Tubes for planting tree seedling nurseries – Improved seeds – Transport facilities such as motor cycles – Agricultural inputs should be in small packages such as 5, 10, 20 (kgs) so that every farmer can afford – Meteorological stations – Power tiller – Capital – Communication facilities eg radio 	<ul style="list-style-type: none"> – Agricultural inputs should be in small packages e.g. 5, 10, 20 (kgs) so that every farmer can afford – Provide farmers with alternative seed crop to suit the current climate situation 	<ul style="list-style-type: none"> – Improve infrastructure and input supplies – Sharing research findings, website, communication, tools, fliers etc, documents on Climate change, NAPA, global perspectives – SACCOS building and ICT for Networking with farmers and businessmen 	<ul style="list-style-type: none"> – Improve infrastructure and input supplies – Improve supply of inputs and implements and packaging of agricultural inputs should be in small 5, 10, 20 (kgs) lots so that every farmer can afford – Improved seeds – Rain gauge for rainfall measurement in the villages – Improve agricultural inputs and implements supplies 	<ul style="list-style-type: none"> – Infrastructure and tools to control quelea bird pests – Financial support – Meteorological instruments and communication facilities – Provide farm inputs eg fertilizer

Source: Stakeholder Consultation survey

A participatory analysis of the stakeholder consultation survey results through national stakeholder workshops and other fora led to the identification of outcome challenges which reflect how the project assessed different boundary partners needs to change in order to adapt to climate change and climate variability (see Table 8 below).

Table 8: Boundary partners and associated outcome challenges

Boundary partner	Outcome challenge
Farmers	<p>The project intends to see farmers are</p> <ul style="list-style-type: none"> – Diversifying crops to increase yields and income, using appropriate soil and water conservation techniques. – Using appropriate crop storage, reducing crop loss and selling at appropriate time when prices are reasonable. – Accessing and experiment appropriate innovations such as small pack of improved seeds and appropriate fertilizers. Accessing, sharing and using meteorological, adaptation and marketing information. – Networking with input suppliers, NGOs, researchers and extension in experimenting, disseminating and sharing new information and agricultural technologies. – Making use of local and technical knowledge in establishing multi-purpose wood lots and other agro-forestry practices, and construct post-harvest storage structures to ensuring food security.
District extension	<p>The project intends to see that extension is:</p> <ul style="list-style-type: none"> – Training and supporting farmers through established Farmer Field Schools and organising them into groups so as to help them plan and access information and products that are appropriate in response to changing climate. – Actively networking with and sourcing and accessing information from internet, researchers, met services, farmers and other extension staff about agricultural adaptation strategies and then translating and sharing this information with farmers. – Documenting major climate events in their localities and their impacts on the communities' livelihoods
NGOs	<p>The project intends to see NGOs:</p> <ul style="list-style-type: none"> – Recognizing the importance of climate change and variability issues valuing local knowledge, providing advisory services, sharing information and experiences, incorporating new knowledge and ideas on CC&V into their capacity building and related activities. – In doing this they will be working more closely with other actors in addressing CC&V issues; participating in local forums, undertaking joint activities and forming new linkages where relevant
Input suppliers	<p>The project intends to see input suppliers/stockists:</p> <ul style="list-style-type: none"> – Stocking appropriate inputs in terms of type, pack size, price and suitability to the localities, and within reach of most small holder farmers. – These stockists are exchanging information on their products with each other and farmers, and monitoring their performance while getting feedback on their performance.
Researchers	<p>The project would like to see researchers:</p> <ul style="list-style-type: none"> – Developing and testing new and improved technologies and disseminating research results. – Networking and sharing research results with other researchers in consortium.
Met service	<p>The project intend to see meteorological services:</p> <ul style="list-style-type: none"> – Undertaking training to teach farmers, collect met data in using it in their farm activities in order help farmers adapt to CC and V; – Issuing or disseminating timely and reliable and seasonal forecasts to farmers. Furthermore, met services should coordinate installation of met instruments at village sites.
Media	<p>The project intends to see a vibrant & dynamic media:</p> <ul style="list-style-type: none"> – Developing and airing both audio and visual programmes targeting farmers on CC&V. The materials for these programmes come from their active participation in project meetings and forums (and this leads to improved information dissemination). – Able to use the knowledge gained from these forums to publish awareness articles on CC&V and any other project information worth disseminating.

v) Enhancing non-farmer stakeholders' capacity to adapt to climate change/variability through improved access, understanding and decision making/ analytical skills.

In order for agricultural service providers to enhance the adaptive capacity of farmers, they themselves need to strengthen their own adaptive capacity ie to become more adaptive. This may need consideration of the vision and governance, management arrangements, capacity and the methods used in working with farmers. Some ideas on this are set out below.

Governance and Vision

- Supports the building up of farmer assets in an equitable manner to strengthen their adaptive capacity
- Incorporate longer time horizons in planning & explore different possible pathways

Management becomes more adaptive

- Base decisions on policy learning and use of climate science and knowledge and develop new practices
- Match to ecological processes at appropriate spatial scales
- Identify alternative scenarios and types of responses
- Evaluate options for resilience
- Understand and challenge assumptions
- Develop frameworks for cooperation between administrative levels/sectors/depts.
- Embrace the diverse motives, incentives and orientations of AAS providers.
- Engage with AIS stakeholders in developing solutions
- Explicitly address uncertainty and incomplete knowledge

Capacity

- Beyond increased investment in capacity building generally, AAS need capacity to: Understand and use climate knowledge and access to information Support for Innovation in Agricultural Innovations Systems (put knowledge into use)
- Greater support for farmer organisation and agency
- Building up of farmer assets and support for equitable institutions

Advisory Methods

- Help clients live with risk, take up opportunities (e.g. new crop varieties, new climate finance), adapt & transform livelihoods.
- Less blanket/static advice. Extension worker moves to giving information, facilitation, advisor on probabilities and trends.
- Better links and relationships between actors in agricultural innovation systems.

Objective 3. To learn and share lessons for scaling up successful strategies for capacity strengthening (individuals, organizations and systems) within agricultural innovations systems to adapt to climate change and climate variability

vi) Impact of project activities on primary beneficiaries (eg women, resource poor and vulnerable groups) and service providers/ policy actors assessed by key stakeholders

In terms of impact on vulnerable groups, in C. Zone in all the FLG there were members who are considered vulnerable eg widows, elderly, orphans, and they are benefiting from the technologies used on the learning plot and their own fields and from the share of the learning plots harvest (see learning visit report for Central Zone Tanzania, 2011). It was suggested that improved seeds and access to tillage equipment such as ploughs could help the vulnerable benefit more. The FLG members felt that the learning group activities have helped them to adapt to CC as the knowledge they have acquired is helping them get much higher yields on their plots of crop such as sorghum, sunflower, and millet, and as a result has increased their food and livelihood security. One group of adopting farmers In Chibelega village explained that the experiential group learning plot approach had opened minds by showing that *“you can increase yields by just using different farming methods and experiments and that differences in yields are not to do with witchcraft which then entails needing to go and visit the Maganga and find out why your neighbour got more than you and what they put in your field etc”*.

vii) Scaling up processes for improved strategies to adapt to climate change/ variability strengthened by key stakeholders.

The project used a Learning Alliance approach to create opportunities for vertical and horizontal interaction and learning between stakeholders at community, sub-national, national, regional and wider levels. Table 10 below indicates examples of how spaces were made for interaction and opportunities for shared learning.

At community level, **Farmer Learning Groups (FLGs)** were identified and/or or developed in eight villages and districts in both Tanzania and Malawi (this was later reduced to six villages in Malawi). **Farmer Learning plots** provided a physical focus for learning activities in each village.

Cycles of **Participatory Action Research (PAR)** were implemented over three years focusing on the FLGs, involving mainly researchers and district extension officers but also NGOs, Met offices, the media and, in Malawi, seed suppliers. Although we envisaged learning platforms being established at sub-national level comprising these different partners this was only very partially successful.

Perhaps more successful were the project team **Learning Visits** which deliberately involved as many team members as possible to interact with the FLG, other key stakeholders and spin-off adopting farmer groups and farmers.

Cross-border learning between researchers has been through the Learning Visits, workshops, planning and M&E meetings.

At national level **National Consultation Groups** representing public, private and civil society were formed by the project and have started to function as a means of interacting and ultimately influencing national decision makers. This appears to have moved ahead more quickly in Malawi than Tanzania.

In Tanzania, a small number of farmers, district extension, NGO personnel and researchers were trained in use of **participatory video**. The main use of video to date has been documentation and sharing by project team members (see Box 1).

Box 1. Participatory video

As with many innovations there has been a time-lag as potential impact and use was internalised and as protocols for working out access to and safety of the cameras were sorted out. We are now starting to see a natural snowballing effect. Our CCAA project teams have acquired greater awareness and interest in the potential use of participatory video to achieve sharing and learning aims.

In Tanzania videos are starting to be used to enhance communication and learning amongst boundary partners in our project and the agricultural innovation system (Table 9). So far the video content has essentially been on project activities. Use of video can now be further extended to exchange experiences between project sites, and to connect to and communicate with policy makers and funding sources. Some examples identified include:

Farmer groups/ CBOs are interested in sharing their knowledge and experiences. This appears to be motivated by a desire to share what they have been doing to adapt to climate change with farmers who cannot physically visit the learning plots. They see this as a way to be recognised as innovators - in the face of climate change and potentially attract development support eg power tillers from District Council and being trained and recognized as seed producers. The Farmer Learning Group in Iramba district (Central Zone) wants video equipment and solar power equipment to run it.

Extension staff in the Morogoro National Learning workshop in July 2010 used a Flip video to capture the presentation of the Met Officer explaining what global warming was and its implications for Tanzania. This can be shared with his colleagues in the Iramba district extension office, and the other groups of farmers that they work with.

Media partners with links to national TV are now working with our project. This provides a channel for broadcasting farmers' climate change adaptation videos on national TV.

Researchers are expressing interest in helping give voice to farmers for expressing their perceptions and needs to policy and other decision makers.

Table 9. Examples of how video has enhanced sharing of experiences and information on climate change adaptation between boundary partners in agricultural innovations system in Tanzania

Boundary Partners	Farmers	Extensionists	NGOs	CBOs	Private stockists	Media	Researchers	Met office	NCG
Farmers	√ ^{1,3}	√ ¹		√ ¹		√ ¹	√ ¹	√ ¹	√ ²
Extensionists						√ ¹			
NGOs									
CBOs									
Private stockists									
Media									
Researchers	√ ^{1,3}	√ ¹					√ ¹		√ ²
Met office									
NCG									

1. National Stakeholder Learning meeting Morogoro July 2010; 2. NCG meeting Bagamoyo September 2010; 3. SabaSaba trade fair Dar es Salaam July 2010

Table 10: Interactions between project boundary partners resulting from project activities

	Smallholder farmers	Public extension	NGOs	Stockists	Researchers	Media	Met Office	NCG
Smallholder farmers	Farmer Learning groups (FLGs) within communities and in districts <i>Malawi:</i> Mulanje DADO field days at Nessa for Mtambalika FLG and neighbouring villages within district FLGs from Mzimba to Karonga district for field day. <i>Tanzania:</i> In Bahi and Manyoni districts DALDO has organized field days at Chibelela and Sanjaranda respectively for farmers from surrounding villages. FLG members for Central Zone villages visited NaneNane agricultural show In Laikala FLG has trained 5 other farmer groups. National Stakeholder workshops within countries							
<i>Public extension –</i>	FLG activities within districts Learning Visits within districts National Stakeholder workshops within countries	FLGs within districts Learning Visits within districts National Stakeholder workshops within countries						
<i>NGOs.</i>	Farmer Learning groups (FLGs) Learning Visits (INADES, FIPS have been in teams; EAM and others consulted) National Stakeholder workshops within countries	Farmer Learning groups (FLGs) Learning Visits (INADES, FIPS have been in teams) National Stakeholder workshops within countries	Learning Visits with INADES & FIPS in teams National St/holder workshops within countries					
<i>Stockists –.</i>	Malawi – NCG includes chair of ASTAM? and farmer representatives. SEEDCO rep promoted seed through FLGs Tanzania – no direct link	Malawi – SEEDCO rep has worked with extension staff while promoting seed with FLGs Tanzania – no direct link	Malawi – NCG and National Stakeholder workshop Tz – INADES purchased mini-packs of seed for FLGs from company in Arusha	Malawi – Chair of ASTAM on NCG Tz No interaction through project				
<i>Researchers</i>	FLG activities with researchers from within country Learning Visits with researchers	FLG activities with researchers from within countries Learning Visits with researchers	FLG activities with researchers from within countries	Malawi – SEEDCO rep has worked	FLG activities with researchers from within countries			

	from Tz, Malawi, UK National Stakeholder workshops with researchers from Tz. Malawi UK MSc students In Chibelela other researchers are visiting	from Tz, Malawi, UK National Stakeholder workshops with researchers from Tz. Malawi UK	Learning Visits with researchers from Tz, Malawi, UK National Stakeholder workshops with researchers from Tz. Malawi UK	with researcher staff while promoting seed with FLGs Tanzania – some seed purchased from stockists in S.H TZ for FL plots	Learning Visits and National Stakeholder workshops with researchers from Tz, Malawi, UK Planning and M&E meetings with researchers from Tz, Malawi, UK Supply of seed for FLG learning plots eg ARI Uyole researchers provided maize, beans in SH Tz. ARI Ilonga researchers provided sunflower seed in CZ			
Media -	Stakeholder workshops Occasional visits to communities by newspapers(Mw, Tz), radio (Tz) TV (Mw Tz) reps	Stakeholder workshops Occasional visits to communities by newspapers, radio TV reps	Stakeholder workshops Occasional visits to communities by newspapers, radio TV reps	Malawi – National Stakeholder workshop; NCG Tanzania No direct links	Stakeholder workshops Occasional visits to communities by newspapers, radio TV reps	Stakeholder workshops NCG		
Met office	Malawi – Met Office has given Climate/ weather seminars at beginning of seasons to FLG in their villages; Stakeholder workshops. Tanzania – stakeholder workshops	Malawi – Met Office has given Climate/ weather seminars at beginning of seasons to FLG and extension staff have been present Stakeholder workshops. <i>District HQ and field staff provide weather data to Met Office on routine basis outside project</i> Tanzania – stakeholder workshops.	Malawi – Met Office Climate/ weather seminars FLG in their villages; ?NGOs present? Stakeholder workshops. Tanzania – stakeholder workshops.	Malawi – National Stakeholder workshop; NCG Tanzania No direct links	Malawi Stakeholder workshops Village CC seminars NCG Tz Stakeholder workshop; NCG.	Stakeholder workshops NCG <i>Met Office disseminated weather info on regular basis via radio, TV, newspaper, internet.</i>	Malawi – UNIMA Met office and Nat Met office in stakeholder meetings, Village CC seminars and NCG <i>NOTE Malawi Met office has changed name to CC & Met Services</i>	NCG meetings Stakeholder workshops
NCG	Malawi - Farmers reps in NCG meeting; Stakeholder workshops Tanzania – individual members in stakeholder workshops	Stakeholder workshops	Stakeholder workshops CARE International rep on Tz NCG	Malawi – NCG ASTAM chair rep Tz -No direct links?	Some project researchers participated in NCG Stakeholder workshops	Mw – Media rep on NCG Tz – Media rep on NCG Stakeholder meetings	Met Office reps on NCG	NCG meetings

In addition, interactions between project team members and international players in the agricultural innovation systems included the following.

- In Central Zone Tanzania Researchers were invited to district Agricultural Development Planning Meetings and in Central Zone and SH Zone Tanzania researchers invited to Regional Meetings;
- SADC team visited Laikala Village in 2009 and reported on it to the ICART programme;
- IDRC / CCAA Advisory Board visited Laikala Village, Tanzania in 2008
- IDRC President visited Nessa Village in Mulanje District in Malawi in 2011;
- University of Pretoria Climate Change Project visited and made a documentary video on climate change in Laikala Village in 2009

8.2. Changes in Scientific research or knowledge innovation

This action research project was focusing on innovation ie getting knowledge into use by different actors in the AIS. To what extent was this achieved?

Smallholder farmers FLG members: Acquired basic knowledge of CC science. Ability to prioritize research needs and experiment in relation to adaptation to CC and CV enhanced :

Public extension Participating Ext staff: Acquired basic knowledge of CC science. Ability to prioritize research needs and experiment in relation to adaptation to CC and CV enhanced

NGOs Participating staff: Acquired basic knowledge of CC science. Ability to prioritize research needs and experiment in relation to adaptation to CC and CV enhanced

Stockists: Some acquired basic knowledge of CC science.

Researchers Participating staff: Acquired basic knowledge of CC science. Ability to do participatory needs identification and prioritization for participatory experimentation in relation to adaptation to CC and CV enhanced.

Media: Participants Acquired basic knowledge of CC science. Ability to prepare articles, radio, TV programmes in relation to agricultural adaptation to CC and CV enhanced

Met Office: Participants acquired knowledge of farmers and other AIS actors needs in relation to climate and weather information

NCG: Some participants acquired basic knowledge of CC science

Table 11: Knowledge acquired by different boundary partners

	Smallholder farmers - FLG Members	Adopting farmers (not FLG members)	Participating - Public Extension	NGOs	Stockists	Researchers	Media	Met Office	NCG
Acquired basic knowledge of CC science	✓✓		✓	✓✓		✓✓	✓		✓
Ability to prioritise research needs and experiment in relation to adaptation to CC&CV enhanced	✓		✓	✓					
Acquired an understanding of farmers experiences of and strategies for adapting to CC&CV		✓✓	✓	✓		✓	✓	✓	✓
Ability to do participatory needs identification and prioritization for participatory experimentation in relation to adaptation to CC & CV enhanced						✓			
Ability to prepare articles, radio, TV programmes, participatory video (PV) in relation to agricultural adaptation to CC and CV enhanced	✓		✓			✓	✓		
Acquired knowledge of farmers and other AIS actors needs in relation to climate and weather information								✓	

Note: Two ticks = almost all, one tick = some of those who participated

In order to strengthen the capacity of AIS to adapt to CC & CV we have learnt that it needs:

- Analysis and understanding of smallholder farmers (from a diverse range of locations in Malawi and Tanzania and gender disaggregated) knowledge, beliefs and practices regards coping with and adapting to CC & CV
- Analysis of the roles (current and potential) of different players within the agricultural innovation systems
- Analysis and understanding of a range of stakeholders within the agricultural innovation systems knowledge, beliefs and practices regards coping with and adapting to CC & CV
- Cyclical multi-stakeholder analysis of farmer acceptance, rejection, critical views on, and demand for different soil water management and agronomic methods and crop varieties for farming in the face of CC & CV in different locations.
- Multi-stakeholder review workshops to share and improve action research processes and activities and to support their scaling up and out.
- Use of outcome mapping approach in acknowledgement of human behavioural and attitudinal changes, continuous learning and self-assessment as the fundamental elements defining outcomes.
- Formation of and support of National Consultation Groups in both countries to advise on relevant national policies and to ensure integration of the project and national challenges and policies

8.3. Changes in behaviour, capacity, action or relationships

We used an innovation systems perspective to identify key boundary partners and changes needed in their behaviour, capacity and relationships in order to respond to climate change and variability.

What changes were observed?

Smallholder farmers

- FLG members using new technologies and practices (eg rainwater harvesting, drought resistant early maturing seed, manure or compost incorporation, row planting with regular spacing, grafting) in their own fields as well as in the learning plot.
- FLG members are sharing weather information with others.
- Some FLG members using Flip cameras to capture activities
- Some FLG members are producing community based quality declared sunflower seed (QDS) of a popular drought resistant variety
- Adopting farmers (eg not FLG members) are copying the FLGs new technologies and practices (see first bullet above for details), after having seen the superior performance of the FLGs crops due to these methods particularly in bad seasons.

Public extension

- Changes not yet apparent.
- May require other organizational and management changes in order that resources etc are in place
- Use of Flip camera by Iramba and Mufindi district staff

NGOs

- INADES motivated to learn more about and share CC information with other farmer networks in Tanzania (eg training of MVIWATA members)
- Sourcing funding to scale out the CC activities of the FLG in other villages or with other groups of farmers
- Collaborating on other CC projects eg INADES Tz worked with Christian Aid exploring the differences and overlaps of indigenous and scientific climate knowledge

Stockists

- SEEDCO now working with FLGs to promote their seed through link with NCG in Malawi

Researchers

- Considering CC implications in research programme activities
- Preparing more and better CC research proposals
- Trying to influence others about importance of CC and links with sustainable agriculture
- Using PAR
- Recognizing need to work with different stakeholders in AIS.
- Acting as CC resource people
- Motivated to participate in the CC debate

Media

- Trend towards greater coverage of CC and other environmental issues in the media. This has made it easier to work with some media actors.
- See Section 7.3. Policy and Media Outputs

Met Office

- Malawi – capacity to interact with FLGs independently in Chikwawa.
- Tanzania – Met Office willing to work with and use FLG weather data.

NCG

- See policy section 8.4 below

8.4 Influencing policy

Influence on policy may be considered in terms of: a) whether a boundary partner has been empowered to influence policy; b) if the has project has influenced a BP's policy and c) whether the project has influenced policy implementation?

Smallholder farmers

- FLG members are better able to articulate their priorities, needs and strategies in adaptation to CC.

Public extension

- Public extension's ability to articulate their priorities, needs and strategies in adaptation to CC has been strengthened but this has been limited by:
 - Movement of staff

- Lack of a regular forum for extension staff in project to interact with each other and other AIS CC stakeholders.
- Project focused on individuals rather than extension organizations.
- Deep tillage promotion included in Iramba DADP (104 Magoye rippers bought for distribution to groups), and by Manyoni district and Bahi district extension. More than 77 Magoye rippers in bought by the extension department in Manyoni district. Use of deep tillage and drought resistant varieties incorporated into Bahi district by-laws to help in adaptation to CC&CV

NGOs

- INADES has joined Pan African Climate Justice Alliance (PACJA) – aims to influence UNFCCC COP meeting negotiations, push African govt negotiators to be more vocal.
- Aiming to influence decision makers to bring DRR and adaptation policy closer together.

Stockists

- No influence here.

Researchers

- In Malawi and Tanzania researchers have influenced other researchers through presentations in various meetings. This has led to other researchers preparing CC related research proposals.
- Proposal preparation is now involving a wider range of stakeholders eg Met Office in Tz.
- Project has started to gather evidence to inform policy. However this may not yet be being shared widely enough to have significant influence.

NCG

- Creative forums can be used to bring researchers and policy makers together. The projects creation of the National Consultation Groups in both Tanzania and Malawi, are an example of this.

General

- Multi-stakeholder collective action learning processes have been used throughout the project, in order to try and bring about ways for stakeholders to interacting differently together and to open up new opportunities and directions
- Policies made at whichever level need take into account the social-economic and agro-ecological diversity of the population. Highlighting the importance of facilitating local level multi-stakeholder learning.

8.5. Technology development, adoption and adaptation

The following table summarises key technology development, adoption and adaptation that has occurred during the project. Further details can be found in sections 6, 7 and 8 of this report.

Table 12: Technology development, adoption and adaptation

Smallholder farmers	Public extension	NGOs	Stockists	Researchers	Media	Met Office	NCG
<p>Tanzania:</p> <ul style="list-style-type: none"> - Farmers are collecting and starting to use data from their weather stations. - Farmers are now purchasing and using the drought resistant and early maturing varieties tested on the learning plot in their own fields (CZ) - Farmers are replacing their slash and burn land preparation practice with deep tillage practices which harvest rainwater in-situ and help their crop survive the dry spells (CZ) - Farmers are producing and selling quality declared sunflower seed (CZ) - In most of the target villages other farmers are now copying the FLG techniques <p>Malawi:</p> <ul style="list-style-type: none"> - Farmers have started growing improved crop varieties suitable for their areas eg in Mulanje, farmers selected one longer and one short duration maize variety to spread climate risk while in Chikhwawa, farmers strictly restrict themselves to planting short duration varieties. - Systematic mono and intercropping of maize and pigeon pea or cowpea and other crops as well as soil and water management practices have also been adopted 	<p>Tanzania:</p> <ul style="list-style-type: none"> - Deep tillage promotion included in Iramba DADP (104 Magoye rippers bought for distribution to groups). - In Manyoni district 75 previously bought Magoye rippers are now being distributed together with training of farmers - In Bahi district, the DALDO is planning to include deep tillage and use of drought resistant seed in their by laws. They are also organising field trips taking farmers from other villages to see and hear about the learning plot activities from the FLG - In Laikala village, the extension worker is supporting 5 other new climate learning farmer groups following the same approach and practices <p>Malawi:</p> <ul style="list-style-type: none"> - In Nessa Village, PE officers demanded and facilitated farmer field days on conservation agriculture where performance was superior. - Capacity of PE to provide extension service according to suitable technologies in specific areas - PE have adopted soil and water management and crop varieties suited to their local area (see annual report for details) 	<p>Tanzania:</p> <ul style="list-style-type: none"> - Sanjaranda Bible College has replicated the FLG approach and techniques - INADES has replicated the FLG approach and techniques in another project - INADES is training farmers through the MVIWATA network on CC science and adaptation <p>Malawi:</p> <ul style="list-style-type: none"> - EAM adopted irrigated crop production technologies (eg crop varieties and soil and water management) and have capacity to respond to provide the right resources (eg human, technological), to facilitate adoption of particular technologies by farmers 	<p>Tanzania:</p> <ul style="list-style-type: none"> - Stockists involvement has been minimal. However farmers have been supported in stocking small packs of popular early maturing drought resistant maize varieties in Maluga village. <p>Malawi:</p> <ul style="list-style-type: none"> - In NCG and stakeholder meeting STAM conceded that inappropriate crop varieties are sometimes sold in a particular area and that in future they should provide more information about which varieties are suitable for which locations as eg from results of CCAA learning plots. This would be tabled in their STAM meetings. 	<p>Tanzania:</p> <ul style="list-style-type: none"> - Researchers have strengthened their understanding of how to facilitate experiential learning/ PAR processes, and listen to farmers requirements before offering suggestions of what they might like to test. - Researchers have increased their understanding of the socio-economic constraints to technology adoption (eg expense of implements, drudgery etc) and are trying to find creative solutions <p>Malawi:</p> <ul style="list-style-type: none"> - Enhanced capacity to analyse farmers needs and develop/ introduce tailored technologies/ innovations for enhanced adoption 	<p>Tanzania:</p> <ul style="list-style-type: none"> - Through their participation in field visits and workshops media have increased their exposure to and understanding of the impacts of CC and the strategies farmers are testing in order to adapt to them. However despite this and the public's interest in CC, involvement of the media has not been easily facilitated. <p>Malawi:</p> <ul style="list-style-type: none"> - Capacity to articulate the CC science and implications for agriculture in Malawi and the dissemination of information to a diversity of clients 	<p>Tanzania:</p> <ul style="list-style-type: none"> - Through making presentations to farmers in workshops and the village seminars, their understanding of the type of information to include and how to relate it has increased. - Access to wider met data sets through weather data from FLG village weather stations <p>Malawi:</p> <ul style="list-style-type: none"> - Capacity to simply and translate into the appropriate language the CC science for dissemination of information to a diversity of clients 	<p>Tanzania:</p> <ul style="list-style-type: none"> - NCG members are aware of the approach and techniques being used by the project and the outcomes. <p>Malawi:</p> <ul style="list-style-type: none"> - Some indication of willingness of NCG members to facilitate decision on technology development and dissemination taking into account the social and agro-ecological diversity in the country

8.6 Changes in the state of economic, social, health, political or environmental conditions

Changes in the state of economic, social, health, political or environmental conditions are summarised below.

Tanzania:

Farmers in the FLGs and adopting farmers state that their yields have increased significantly as a result of the practices they have tested in the learning plots and now adopted on their own fields. They state that this increased yield has helped them in: becoming more food secure; not needing to migrate so regular to look for casual labouring opportunities (Men Laikala FLG); purchasing assets. They are also more concerned about environmental deterioration and most FLGs have been planting trees. All the stakeholders involved feel their knowledge and understanding regards CC and CC adaptation has increased. The multi-stakeholder learning alliance approach used, has helped increase the voice/power of the FLG farmers through involving them in the decision making, planning, and multi-stakeholder implementation of the project.

Extension and local policy makers have reported that their involvement in the project has helped them to feel (through the FLG experiences) that there are practical ways of adapting to CC that farmers can develop, helping them see the opportunities as opposed to just the challenges.

The NCG members have explained that Tanzania is looking for these kinds of participatory initiatives to scale up, and that as they don't yet have funds to support many of the proposed NAPA initiatives, it is important that other funds are being used to support such timely and important learning, which can then be used by Tanzania at scale.

Malawi:

Farmers in the FLG now have a more diverse range of agriculture produce for food and nutrition at household level due to new crop varieties and improved production methods. Irrigated maize production in Chikhwawa has allowed the production of maize, sweet potato, vegetables in the dry season. Availability of quality food implies healthy life and social economic status of farmers.

Public extension and researchers have enjoyed the satisfaction of being an important part of a process developing/ disseminating technologies/ innovations to farmers which have enhanced these farmers lives.

Stockists have potentially increased profits due to widespread adoption of some of the crop varieties they sell, due to increased farmer exposure to them during the testing of them in their learning plots.

9.0 Overall Assessment and Recommendations

The overall objective was to strengthen the capacity of individuals, organizations and systems within the agricultural innovation systems in less favoured areas (semi-arid Central Zone-Singida and Dodoma, Tanzania and Chikwawa/Karonga, Malawi) and more favoured areas (Southern Highlands, Tanzania and Mulanje/Mzimba Malawi) of Tanzania and Malawi to adapt to the challenges and opportunities arising from CC & V.

Usefulness of Partnerships in achieving the overall objectives

- A strong partnership has developed between the three collaborating institutions: IRA, Tanzania; NRI, UK; and NAREC, Malawi. The institutions are now collaborating in implementation of other projects as well.
- However the project has operated using a project team approach to share planning, implementation and lesson learning. Some of the members of the project team have changed over time due to individuals moving organisation, individuals being away for extended periods of further study. In addition to IRA, NAREC and NRI, the other key individuals in the project team came from, in Tanzania: ARI Hombolo, ARI Uyole, INADES Formation Tanzania, in Malawi: Bvumbwe Agricultural Research Institute, and Bunda College. In Tanzania these organisations took charge of ensuring the action research happened on the ground.
- Due to the design and approach of the project at each learning site different key actors from the local agricultural innovation system were involved. This has strongly involved partnerships with and between farmer learning groups, village based extension officers, district level extension officers, local NGOs. It had been initially hoped to build stronger partnerships with agro-input stockists, media and meteorological officers, whilst they were involved in the project at some of the learning plot sites and often at national level, the level of participation was not what we had initially envisaged.
- Team working established through such partnerships made full use of the complementary but different skills and experiences of the individuals and organisations.
- The approach taken in implementing this project was supported by the CCAA programme of IDRC, and a strong relationship has developed between them and the IRA of the University of Dar es Salaam, Tanzania

Contribution of the project to development

The economies of Tanzania and Malawi depend on agriculture. This project contributed to a number of important issues for developing and strengthening the resilience of agriculture in these countries including:

- Highlighting the role of local agricultural innovation systems (AIS) in bringing about change, and in not only getting knowledge into use but also scaling-out the use of that knowledge through the AIS actors' different networks and activities.
- Facilitating multi-stakeholder learning processes, helping to broaden understanding that there are few if any one size fits all solutions and therefore the importance of strengthening different actors skills in experimenting/discovery learning to see which are the more suitable methods and approaches for their own situation and role.
- Bringing the different AIS actors together also helps build relationships and trust for future activities. Eg stronger linkages between researchers and NGOs, between met officers and extension will help in ensuring information flows and collaborative activities in the future.
- The project facilitated the testing by multi-stakeholder groups of a range of agricultural adaptation to CC technologies and processes, which will also be important to other areas with similar agro-ecological and socio-economic conditions.
- The project has raised a great deal of awareness about: CC, how CC is impacting on rural livelihoods in different locations, possible options for adapting to CC, ways of collaboratively working in order to address complex multi-faceted and uncertain problems such as CC. It has

built the AIS actors involved confidence in understanding, discussing and being able to address CC issues.

- While it is not easy to recognize changes in terms of development within a short period of time. The capacity building through this project in terms postgraduate training focused on deepening understanding of CC impacts on rural communities, and agricultural adaptation to CC. In time these individuals are likely to take roles in various organisations and use their understanding of CC and adaptation issues in influencing the activities of those organisations.
- Through the use of the AIS approach, the project understood the need to work with all kinds of relevant stakeholders, and has helped in facilitating improved linkages between some. For example in Malawi, discussions were held with Ilovo sugar company in Malawi to ensure that sufficient irrigation water for farmers in the surrounding community were available during the full length of the growing season, in Tanzania district councils decided to use their budgets to supply (often on a shared cost basis) power tillers and Magoye rippers to active farmer learning groups having seen the impact of these implements when used together with strong and practical field training and understanding of the tillage principles behind them.
- Other farmers in the learning villages and in surrounding villages have adopted many of the techniques and approaches used by the projects farmer learning groups. This is likely to continue to increase over time, as more farmers validate the importance of these techniques in their own situations for helping in adapting to CC. Other players in the AIS eg extension and local NGOs are also replicating the approach and techniques using their own resources.
- The CCAA program and project teams have helped to build the capacity of African scientists to lead large projects.

Lessons for future projects

- We have learnt that the learning alliance approach we used in this project is important for ensuring that the relevant players in the AIS work together to bring about meaningful and lasting change in their practices. However, such multi-stakeholders processes take time to develop (even when some of the actors are already known to each other), and are therefore resource intensive. For complex multi-stakeholder processes such as these a longer timeframe of implementation would bring significant returns. For example, in the current project it is just this year that we are seeing: other AIS actors buying in to the projects activities and replicating them with their own funds, neighbouring farmers starting to copy the farmer learning group processes. These farmer learning groups have now developed a good understanding of CC and its potential impacts, and first hand experience of some agricultural options and processes for addressing it. If supported, they and the other local AIS involved can act as important resource persons in scaling up the learning and bringing significantly increased returns to the investments already made.
- Partnerships while often tricky and time consuming to manage, add significant value projects such as these. Such partnerships between organisations in the South and North, between organisations in different countries in the South and between different organisations within local agricultural innovation systems need to be encouraged, and this must be from the very early stages of a project to build in time for relationship growth and ownership.

Relevance/value and importance of the project

- Compared with other research projects and development programs that involve communities, this project despite its relatively small resources achieved a lot (see sections 6,7 and 8 of this report for details).
- A lot of scaling out and up activities are now resulting from this project, highlighting that its approach has been practical and the work timely given the increased interest in and understanding of CC adaptation that is now developing amongst many different players in the AIS.

- The funds allocated to this project were sufficient due to critical and costed analysis of what could be done each season during the planning stages. Over 90% of what was planned has been achieved.
- The action research needs to continue but a challenge is how? While the use of an agricultural innovation systems approach is about building relationships between different players so that they will continue beyond the short lifespan of a single project, those relationships take time and resources to develop, and we wish there was some way of helping to ensure these learning alliances continue during these early years in which they are just beginning to see their own potential.

Recommendations to IDRC

- The approach used to implement A CCAA program that is giving an opportunity for African Scientist to lead large research program is praised and needs to be encouraged
- The interaction between IDRC through CCAA advisory management board, IDRC top officials including the President was quite useful in terms of enabling higher level officials to value on going projects and also to build confidence of researchers. This spirit needs to be encouraged to continue
- IDRC needs to identify successful projects/programs and support appropriate ways of scaling up and out the findings (approaches and technologies).
- IDRC should support policy dialogue workshops once the projects are over, so that key lessons and information are shared to maximise the value of these investments and processes.

Appendices

Appendix 1. Farmers' changing capacity to adapt to climate change and climate variability

a) Tanzania

LOCATION	HIGHER POTENTIAL S. HIGHLANDS		LOWER POTENTIAL CENTRAL ZONE	
Livelihood theme	MBEYA	IRINGA	DODOMA	SINGIDA
Crop diversity – wider range of new crops and varieties (see also Table 2, outcome 3).	Introduction of new beans and wheat varieties in Kapugi	Introduction of new avocado, banana and maize varieties in Nyombo village	For example new sunflower, sorghum, maize varieties in Laikala and Chibelela villages	For example new sunflower, maize, sorghum, lab lab varieties in Sanjaranda and Maluga villages
Crop resilience – seed of varieties more suited to weather conditions	See Table 1 outcome 3	See Table 1 outcome 3	See Table 1 outcome 3	See Table 1 outcome 3
Access and ability to keep livestock – which can act as a buffer,	eg Kapugi group accessed pigs from Rungwe DALDO office			
Ability to store food			Trained on use of storage pesticides such as Actellic super in Laikala and Chibelela villages as improved sorghum vars. were more susceptible to storage pest damage than traditional vars	Trained on use of storage pesticides in Maluga village
Financial capital	Eg Mpunguti group received treadle pumps for irrigating vegetables	Eg Nyombo group accessed a power tiller on shared cost basis from Njombe DALDO's office	Eg Chibelela sunflower producers were linked to newly established oil milling plant	Eg Sanjaranda learning group received a power tiller from the district council
Natural capital	-	Eg Nyombo village, Iringa received support in raising natural tree seedling to be planted. Mwitikilwa village raised and planted pine trees for timber production and soil conservation	Eg Laikala and Chibelela village gained knowledge on tree planting and improve soil management	Eg Improved soil productivity
Human capital – better understanding of weather, knowledge of managing (new) crops	Eg planting of new rice varieties and use of treadle pumps in Mpunguti village.	Eg Knowledge in managing banana and avocado plant and tree respectively.	Eg increased capacity for recording rainfall and temperature and making interpretations. Increased capacity of farmers in managing soil and water harvesting using deep tillage and ridges	Eg increased capacity for recording rainfall and temperature and making interpretations. Increased capacity of farmers in managing soil and water harvesting using deep tillage and ridges
Physical capital	Eg. Treadle pump	Eg. power tiller	Eg. Access to Magoye ripper, spring jembes	Eg. Access to Magoye ripper, spring jembe