



Emerging approaches for responding to climate change in African agricultural advisory services

Challenges, opportunities and recommendations for an AFAAS climate change response strategy



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Pictures are from a Climate Change Adaptation for Africa (CCAA) project *Strengthening local agricultural innovation systems in less favoured and more favoured areas of Tanzania and Malawi to adapt to the challenges and opportunities arising from climate change and variability* (jointly funded by DFID and IDRC).

Clockwise from top left:

Nyombo village (Tanzania) climate change learning group secretary examining newly planted avocado in group learning plot (enhancing access to and mangement of agrobiodiversity) (Richard Lamboll)

Trainee filming another trainee during the McKnight Foundation CCRP/CCAA Participatory Video training, Dodoma Tanzania 2009 (Nick Nathaniels)

Mwitikilwa village (Tanzania) climate change learning group member explaining use of the group's newly installed weather station (Richard Lamboll)

Sanjaranda village (Tanzania) climate change learning group members in group learning plot (improving access to crop varieties and soil and water management) (Richard Lamboll).



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Executive summary

Responding to climate change is one of the major challenges for agricultural advisory services (AAS) in the 21st century. As a regional umbrella organisation, the African Forum for Agricultural Advisory Services (AFAAS) has a critical role to play in supporting AAS systems to respond effectively through knowledge management, support for innovation, and organisational change. This report, drawing on a rapid desk-based review, seeks to outline the potential role of AAS in addressing climate change and explores how far AAS in sub-Saharan Africa (SSA) are able to respond to climatic and other pressures. Recommendations are outlined, indicating how AFAAS can help AAS to understand climate change better and become more ‘adaptive’ in their responses.

Climate change, agriculture and advisory services: challenges and opportunities

It is widely accepted that human activity is increasing the level of greenhouse gases (GHGs) in the atmosphere, causing global warming. This is leading to changes in weather patterns, although the actual changes will differ significantly by location. Agricultural lands occupy over 37 percent of the Earth’s land surface. Agriculture is a cause of climate change – as it is a major emitter of GHGs – but will also be affected by it. Impacts will not be felt evenly. Smallholders’ crops and animals, production and livelihoods will be affected directly and indirectly through off-site impacts and as a result of climate change responses. Modelling the impacts of climate change is complex and there are uncertainties, but many areas of Africa are likely to be severely compromised by climate change and climate variability, adversely affecting food and, in places, water security. Climate change impacts will be greatest where they interact with other shocks, stresses and vulnerabilities.

Increasing demands are being placed on agriculture – food, economic development, reducing GHG emissions and providing other ecosystem services. While there is some consensus about the broad challenges, there is less agreement on the best ways of addressing them and the most appropriate agricultural development pathways. The assumptions that underpin current visions of agricultural development may need to be revisited as climate change challenges ‘business as usual’ models, with increased attention to resilience, ie, the capacity to cope with and recover from shocks and stresses. Given the multiple demands placed upon agriculture, a number of potential synergies and trade-offs are emerging between agricultural production and climate change adaptation and mitigation objectives. Where there are trade-offs rather than synergies, governments, farmers and other agricultural innovation system (AIS) actors will need to prioritise actions and *climate resilience* will be a key factor in future agricultural systems.

Africa's population is projected to double to two billion people by 2050, and globally food production will need to double in order to meet the needs of increasingly urban populations. Urbanisation is occurring rapidly in SSA, but large rural populations are projected for at least another generation. In SSA, greater areas of land are under range lands or other land use, with relatively small areas under agriculture or forests. Large areas exist where the climate is unable to support rainfed agriculture. Among other factors, climate change, increasing population and food security highlight the importance of various ecosystem services and the finite nature of land resources.

Agriculture continues to play a key role in most African countries, but this is the only region of the developing world where food production per person has not increased since the early 1970s. The absolute number of undernourished people has risen. Studies suggesting that agricultural trade facilitates adaptation and brings global benefits emphasise the importance of removing trade distortions, such as subsidies. However, others point out that adaptation in developing countries through increasing trade would be severely constrained by limited buying power. Meanwhile, climate change is creating new markets for farmers, such as biofuels and the carbon market.

Responding to climate change

Responses to climate change are usually grouped into two main categories: mitigation (addressing causes) and adaptation (addressing effects). In agricultural adaptation there is a need for new technologies and farm-level innovations, but also changes in broader institutional arrangements (eg, greater equity in land ownership, adaptive management in relevant organisations). There is a range of options to generate incremental changes at farm level – eg, adaptation of agricultural practices, adapting livestock, pasture and rangeland management, farm-level climate change mitigation practices, and diversification of species and varieties. Others options are strengthening farmer organisation and networking, taking up of new climate finance, and developing value-chain opportunities. However, progressive climate change is likely to require more major responses such as complete changes in farming systems, livelihood diversification and migration. The diversity of farming contexts, the complexity of livelihood strategies and the uncertainties of climate change, combined with other factors, suggest a need to support *localised innovation to enhance and sustain agricultural performance and resilience*.

Agriculture is a major source of GHGs (10–12 percent or more of the total) and thus a major cause of climate change. There is significant potential to mitigate these emissions by changing agricultural practices to reduce emissions, store or capture carbon and reduce fossil-derived emissions through production of biofuel feedstocks. Promising options for mitigation include improved crop and grazing-land management, restoration of organic soils and restoration of degraded lands. Despite significant technical knowledge, relatively little progress has been made in implementing agricultural mitigation measures. There is no universally applicable list of mitigation practices. All practices need to be assessed for their appropriateness to individual agricultural systems and clear incentives and capacity strengthening are required.

Shifting towards more 'adaptive' AAS

To achieve more adaptive AAS will require changes – in roles, capacity, structures and partnerships, funding, governance and visions of agricultural development. New roles may

include: improving access to and use of climate science and other forms of climate knowledge (eg, local, indigenous observations and adaptations); analysing the changing drivers of farmer vulnerability and resilience; strengthening adaptive capacity and resilience; and offering climate mitigation and low-carbon development in agriculture.

To fulfil these new or expanded roles, what will AAS need to look like, ie, how will AAS become adaptive? AAS will need to be able to manage uncertainty and incomplete knowledge, by understanding potential risks and by being flexible; be better able to respond to change and unpredictability by supporting farmers to live with these risks and to take advantage of opportunities; and embrace multiple providers of AAS given the diversity of rural situations that exist and the different motivations and orientations of the providers (Christoplos 2010a). A key change will be to move towards adaptive management.

Some of the key features of adaptive AAS

Drawing on existing frameworks, some of the key features of adaptive AAS include:

- Enabling farmers to build up their assets to respond to a changing climate
- Supporting equitable access to assets/resources, especially by the most vulnerable
- Supporting farmer self-organisation in the light of climate change challenges and opportunities
- Enabling technological and institutional innovation at farm and policy levels for adaptation and mitigation
- Strengthening AAS climate knowledge, including supporting/learning from farmer climate knowledge
- Moving towards adaptive management:
 - Basing decisions on explicit learning from policy experiments and using new scientific information, technical knowledge and farmer knowledge to improve understanding, inform future decisions, monitor the outcome of interventions and develop new practices
 - Longer timescales in planning and capacity strengthening
 - Explicitly addressing uncertainty
 - Evaluating alternative scenarios, structural and non-structural measures
 - Understanding and challenging assumptions
 - Aligning with ecological processes at appropriate spatial scales
 - Having frameworks for cooperation between administrative levels, sectors and departments (for more integrated approaches)
 - Supporting sustainable mechanisms for learning.

All aspects of AAS – including *governance, vision, management, capacity* and *advisory methods* – may need to change to enable adaptive AAS. We identify trends in current AAS systems, although practice differs across countries. The overall guiding frameworks in the past emphasised a transfer or linear model (from researchers to the public extension service to farmers). In some cases this is still the case in practice. But in others, other innovation-system actors in the private sector and the ‘third sector’ (NGOs, farmer-based organisations)

are recognised. Funding and provision of services has thus become more pluralistic and processes of decentralisation are significant, although with mixed results. There is also an increased emphasis on diverse partnerships and linkages in AIS. Advisory methods are shifting from top-down message-based working with model farmers such as training and visit (T&V) systems to more participatory, learning-by-doing, and group-based approaches (eg, farmer field schools). The content of AAS has expanded from an almost total focus on production, to more emphasis on, eg, marketing.

In terms of AAS management, there have been drives to increase accountability to the clients, ie, the farmers or other AIS actors, as well as line managers and funders. The use of information and communications technology (ICT) has expanded with the mobile-phone revolution in SSA and increasing access to the internet. However, access is still limited in many rural areas and the full potential of ICTs has not been fully explored. There is more explicit rhetoric on improving targeting and gender sensitivity, but action is still variable.

The wider policy context

Wider policy contexts can be as important as specific climate change and agricultural policies in terms of capacity to adapt to climate challenges. Structural adjustment and liberalisation policies and poverty reduction strategy papers help to shape economic pathways. At the continental level, the agriculture vision of the African Union's New Partnership for Africa's Development (NEPAD) is captured under the Comprehensive Africa Agricultural Development Programme (CAADP), which seeks to eliminate hunger and reduce poverty through agriculture. African governments have agreed to increase public investment in agriculture to at least 10 percent of their national budgets and raise agricultural productivity by at least 6 percent. While agricultural productivity objectives feature strongly, there is little explicit mention of climate change in CAADP themes.

Many countries appear to be juggling competitiveness, economic growth and food security through freer trade with the goal of achieving food security through increasing domestic agricultural production. After years of state withdrawal from agricultural support, many governments are investing in agriculture, but often with limited clarity on the role of and support for AAS. There is little explicit mention of climate change in agricultural policies and strategies. Policies are generally supportive of agricultural practices that focus on increasing short-term production (eg, expansion of agricultural land, increasing mechanisation, increasing use of fertiliser and other inputs). They are generally less supportive of practices which can improve food production, enhance adaptive capacity and address mitigation (eg, restoration of degraded land, improving soil macro and micro nutrients). Decentralisation is likely to be a necessary element of climate change adaptation, but although widespread, progress in implementation varies.

National-level *climate change policies* are emerging, although levels of implementation and coordination differ across countries. Lead responsibility for climate change issues within governments tends to be in the ministry responsible for environmental issues. National Adaptation Programmes of Action (NAPAs) have been submitted by least-developed countries (LDCs) to the United Nations Framework Convention on Climate Change (UNFCCC) since 2004, which make these countries eligible to apply for funding from the Least Developed Countries

Fund (LDCF). Strengthening farmer adaptive capacity features strongly in a number of NAPAs. Some NAPAs highlight the importance of AAS in adapting to climate change, but also note their limited capacity in this regard. Implementation of NAPAs has been constrained by a lack of funding. A number of countries have also developed Nationally Appropriate Mitigation Actions.

Concern over longer-term climate change has been primarily internationally driven. Although many developing countries are signatories to international agreements (eg, UNFCCC, Kyoto), at local and national levels there are often more pressing concerns about immediate environmental impacts. There is significant donor influence over national policy making and many of these agencies have turned their attention to climate change (mitigation and adaptation). Some, such as The World Bank, have major programmes across a number of countries. Increasing numbers of donor-funded climate change initiatives are being funded. Many international NGOs are fully engaged in climate change activities – including some in partnerships and multi-country initiatives. However, there is still only limited evidence of impact, because many are still in their infancy.

Current AAS characteristics and ‘adaptive’ capacity

We explore the current features of AAS in SSA to assess how far they are ‘adaptive’, ie, able to respond to climate change. We consider the vision, governance, capacity, management and advisory methods for each of public, private and third sectors.

Visions and governance: In terms of visions of agricultural development, the pathways of production-innovation and growth narratives are fairly prevalent. Public policy on agricultural innovation is focused on high resource use (inputs, energy and water). Some organisations in the third sector and some individuals across the AAS sectors are embracing less resource-intensive visions of agriculture and innovation. The United Nations Environment Programme (UNEP) attempts to de-couple economic growth from high resource use and is promoting a ‘green economy’ approach; associated innovation is likely to come from the developing world. In all three sectors, visions of success appear to have relatively short-term horizons largely driven by political necessity, funding-agency timelines or profit imperatives. Exceptions include the 2020 vision process led by the public sector; various climate change alliances in the third sector; and Corporate Social Responsibility in the private sector. Most funding appears to be striving for short-term success with little real consideration of sustainability and strengthening adaptive capacity. Many governments seek to address equitable agricultural development through poverty reduction strategies and in, eg, specific gender policies. However, how this is prioritised, interpreted and implemented by AAS varies. The need for strengthening farmer organisation tends to be viewed differently across the AAS sectors. Many in the third sector aim to strengthen farmers’ ability in negotiation, advocacy and securing rights. In the private sector, the motive varies from the need to secure produce on a regular basis to ethical trade concerns. Public-sector AAS are working with farmer groups as a cost-effective way of delivering AAS. Government policies emphasise a need to embrace scientific knowledge and associated technology, eg, modern crop varieties. The third sector has tended to place more value on local knowledge than the other two sectors. National environmental policies generally embrace United Nations (UN) agreements on, eg, biodiversity, desertification and climate change. However, CAADP and national policies prioritise increasing productivity and therefore implicitly resource-intensive farming, in some cases subsidised by governments. The third sector appears most interested in adapting through alternative innovation, but probably has least capacity.

In terms of *adaptive management*, it is mainly NGOs that have explicitly addressed the issue of strengthening farmer adaptive capacity. Many funding agencies still emphasise shorter-term impact rather than longer-term capacity strengthening. NGOs have tended to take the lead among AAS organisations in terms of targeting different groups, particularly the most vulnerable, although it is becoming more common in public-sector AAS. Typically, public- and third-sector monitoring systems are project based and some are measuring performance in terms of improving access to and control of assets by different groups. Pressure to demonstrate short-term impact creates an incentive, though, to work with groups with more assets and focus on shorter-term livelihood impacts. Evaluations rarely assess longer-term impacts and there is only limited experience in monitoring and evaluation of climate change programmes and interventions. It would be expected that rewards for localised innovation should be greatest in the private sector. In the agribusiness sector, however, there appears to be little evidence of innovation.

AAS capacity: AAS need to be able to explore different scenarios with farmers and other AIS actors. The facilitation skills and some of the concepts to do this are currently more likely to be found in the third sector, but overall capacity in this area is almost certainly limited. To strengthen adaptive capacity, AAS organisations need to be able to recognise gender and social inequality and to develop strategies to address them – including the new pressures and vulnerabilities created by climate change. Capacity is often greater among NGOs, but not always, and there is increasing recognition in some public-sector organisations. Private-sector capacity and motivation varies depending on the type of organisation. Self-organisation is a key element of adaptive capacity. This again has tended to be a strong feature of the third sector, including farmer organisations themselves. There is increasing capability in some public-sector organisations, although it remains an open question as to what extent public AAS can play this role. Private-sector capacity and motivation varies depending on the type of organisation.

Climate change has only emerged recently as a critical issue and so most AAS individuals have received little specific training in relation to climate change in their formal education. Most African training organisations have little capacity in this area. Accessing and using knowledge and information in general has certainly been an issue for most public AAS organisations, which have often tended to be passive recipients of information. This is changing, but many AAS actors have limited capacity to actively seek and use new knowledge and information. The diverse environmental and social contexts of Africa suggest a need for localised agricultural innovation and climate change is strongly reinforcing this imperative. This requires the ability to: (a) identify and analyse challenges and opportunities, (b) access information and know-how, and (c) put the newly acquired knowledge to use. The ability of AAS individuals and organisations to contribute towards innovation is determined by their internal capacity and the wider AIS in which they operate. After years of underinvestment in African AAS, it should be no surprise that internal capacity is limited, but there are some signs that this is improving. However, further major investment is needed to strengthen AAS capacity in relation to agricultural innovation. AAS organisations operating in Africa have experienced major change over the years, often driven by government or funding-agency decisions. Third-sector and private-sector organisations have often shown a greater ability to adapt to change than the public sector.

In moving towards adaptive AAS, the *advisory methods* used are critical. In dealing with climate change and other uncertainty, such methods need to emphasise aspects such as: strengthening

capacity of clients (rather than delivering messages), strengthening the self-organisation of farmers, and enhancing local-level innovation. There has been a major move, particularly in the public and third sectors, towards more learning-based approaches to working with farmers, eg, farmer field schools. If implemented with commitment, these approaches can make an important contribution towards strengthening adaptive capacity.

Using appropriate advisory methods with different rural people has tended to be a strength of the third sector, which often targets more vulnerable groups. Methods have tended towards working with farmers in various forms of collectives. However, how these methods are implemented makes a huge difference in terms of longer-term change and real capacity for self-organisation. Methods such as farmer field schools explicitly encourage experiential and shared learning. Learning alliances, which encourage learning among key stakeholders at and between different institutional levels, can play an important role in climate change adaptation. Climate change is starting to be addressed by the third and public sectors through various projects. But it is much harder to assess the private sector, where information is much less readily available. Methods such as farmer field schools do enhance adaptive capacity and there are examples where this is being applied to climate change, eg, biodiversity schools in West Africa and climate change schools in Indonesia.

Some examples of climate change responses in action

Improving the availability of, access to and use of climate science and other types of climate knowledge among different stakeholders is critical. Some examples are presented. Adaptation initiatives can range along a continuum from addressing broad drivers of vulnerability, to strengthening response capacity to managing climate risk, to confronting climate change. A range of examples is presented organised according to themes of: addressing vulnerability, managing natural resources, community adaptation, community-based adaptation methodologies, communication and scaling up, value-chain approaches, insurance and microfinance, and the role of ecosystems in adaptation.

A number of initiatives have also been identified in mitigation. Smallholders may be able to access significant levels of payments for the environmental services that they provide. Low-carbon agriculture may mean modifications to existing production systems, but would also need to address national and global food security and adaptation. AAS could have a critical role here in facilitating debate on priorities and on where there are synergies and trade-offs. Strong AAS support is also urgently needed in improving farmers' access to information about climate market mechanisms, such as reducing emissions from deforestation and forest degradation and enhancing forest carbon stocks (REDD+). As legislation is starting to require the use of liquid biofuels for transportation in developed countries, biofuel production is increasing. AAS organisations have an important role to play in advising farmers and other actors on the more sustainable and equitable biofuel schemes and appropriate business models.

A selection of existing carbon payment for environmental services (PES) projects in Tanzania, Ethiopia, Uganda, Kenya and Mali are reported. Emerging lessons include that a good aggregator is essential (especially one that can also advise on agricultural practices) and methods for monitoring must be simple, accessible and transparent to the farmer. While there are huge potential opportunities in PES, there are also major institutional challenges and issues, such as concerns about equity and the distribution of costs and benefits.

Climate finance

Increased recognition of climate change challenges has led the international community to create new climate finance mechanisms and funds. Public and private sources are funding adaptation and mitigation. Climate finance provides a potential means to reconcile equity with effectiveness and efficiency in actions to reduce emissions and adapt to climate change. However, current levels fall far short of estimated needs. Over 90 percent of the climate change funding in 2010 was directed to mitigation activities. Several studies have recently reviewed the costs of adaptation and agree that: climate change is ongoing and further significant impacts are inevitable; the costs of adaptation are difficult to estimate; and the costs will be high. The LDCF and the Special Climate Change Fund (SCCF) of the Global Environment Facility (GEF) are key funding sources for adaptation.

Carbon markets are derived from an appreciation of the need to control or reduce the global build-up of GHGs in the atmosphere. The two main options are for entities to reduce their own GHG emissions or to offset these by paying for emissions to be reduced by others elsewhere. The latter option has created markets for GHGs. There are two main types of markets – regulated/compliance and voluntary. In 2010, the international carbon markets transacted 6823 million tonnes (Mt) of CO₂ equivalent (CO₂e), valued at US\$ 124 billion. The voluntary markets contributed a small fraction of volume and value (about 1.9 percent of volume and 0.3 percent of value).

The opportunities for agriculture in developing countries are currently limited. In 2010, some 497 projects in agriculture, forestry and other land use mitigation (AFOLU) were identified around the world. Although almost 20 percent of the projects were based in Africa, this figure is reduced to only 3.5 percent if projects not registered under any carbon trading scheme are excluded. Almost half the AFOLU projects are targeting improved manure management by owners of cattle, poultry or pigs, particularly in Latin America, North America, Asia and the Pacific. The 10 African soil-carbon projects (Senegal, 5; Mauritania, 1; Madagascar, 2; Kenya, 1; Sudan, 1) all appear to be outside of carbon trading schemes. However, the first ever African soil-carbon deal was signed in November 2010, which should bring benefits to Kenyan farmers through the World Bank Biocarbon Fund. The implementing organisation (project developer) may or may not be the land steward and a wide range of arrangements appears to be emerging. Development and conservation NGOs may be the project developer. For example, World Vision has developed a project in Ethiopia converting 503 ha of grass and crop land to forest, targeting 3000 farmers.

Conclusions

The multiple demands being placed on agriculture, the dynamic and complex contexts in which AAS are expected to perform, and the impact of climate change present challenges and opportunities for AAS. AAS organisations may reflect on how adaptive they are now and what it might take for them to become so in the future. AAS are in many cases already undergoing changes, because of decentralisation processes, for example. However, many are ‘sticky institutions’ that are resistant to change, particularly in the public sector. The resistance to change is partly due to a lack of investment, but also to the political economy of decision making which can undermine adaptive features of AAS. Climate change, in particular, means that to perform effectively, organisations will have to reflect upon their guiding narratives and visions, objectives, structures, and ways of working.

Climate change is exacerbating an already risky and uncertain SSA agricultural context. Business as usual may not prepare rural communities and countries to face progressive climate change and increasing frequency of extreme events. Vulnerable groups in developing countries will be the most hard hit – although the impacts will not be felt evenly. In diverse rural situations, it is most likely that different types of agricultural development pathway will be appropriate, with engagement from different stakeholders in localised processes of innovation and learning. This may involve different providers of agricultural advice and support, and may challenge the conventional approach to economic growth in certain situations. In agriculture, AAS will need to improve the capacity of smallholders and others to manage increasing risk and uncertainty under climate change, recognise and embrace more pluralistic systems of AAS delivery, and be able to respond to change and unpredictability.

New investment in agricultural development is urgently needed and this provides an opportunity for AAS to shift towards adaptive management. This is essentially an approach to guide intervention in the face of uncertainty. The principles outlined should help guide AAS to respond to climate change in a way that meets the scale of the challenges ahead. Key principles include: Basing management actions on explicit learning from policy experiments and the use of new information and technical knowledge to improve understanding, inform future decisions, monitor the outcome of interventions, and develop new practices. Adaptive management has a long time horizon for planning and capacity strengthening, and is aligned with ecological processes at appropriate spatial scale. It creates an enabling framework for cooperation among administrative levels, sectors, and line departments; broad stakeholder participation in problem solving and decision making; and adaptable legislation to support local action and respond to new information.

Recommendations

AFAAS should:

Influence the wider AAS context

1. Advocate to decision makers at appropriate levels to give space and provide incentives for AAS to respond to climate change issues.
2. Leverage funding opportunities that can contribute to planning with a longer time horizon.
3. Support increased investment from governments, donors, private sector and NGOs in adaptive, climate-resilient agricultural development – in particular, AFAAS should advocate the NEPAD CAADP target of at least 10 percent of government expenditure allocated to agriculture but with a view to developing adaptive AAS.
4. Contribute to the debate on the balance between large-scale ‘silver bullet’ type approaches, and localised agricultural adaptation/innovation.
5. Encourage policies that support the identification of alternative potential agricultural development pathways and assessment of most appropriate options.

At AFAAS level

1. Revisit AFAAS vision, mission and purpose in the light of climate change challenges and opportunities.

2. Create partnerships and linkages with other actors to improve AAS with respect to climate change.
3. Use networks to share lessons – particularly among AAS in agro-ecosystems that already face a specific challenge and others that are likely to face this in the future.

At AAS organisational and individual levels

Vision and governance

1. Play a role in making different stakeholders' visions and beliefs of agriculture, innovation and the role of different actors more explicit, and the implications of different options more widely understood, creating space for alternative narratives informed by climate change knowledge.
2. Facilitate a process of visioning among AAS stakeholders at all levels, exploring the different agricultural development pathways that might exist in the light of a changing climate, and the balance between climate resilience of equitable production/distribution systems and healthy ecosystems and productivity maximisation. Share the concepts of the green economy and decoupling of natural-resource use and environmental impacts from economic growth.

Adaptive management

1. Facilitate the sharing of adaptive management concepts among AAS, and facilitate learning from experience in AAS about how best to move towards adaptive AAS management systems, approaches, incentives, etc., drawing on the principles outlined above.

Capacity strengthening

1. Facilitate sharing of information to improve understanding of climate science, including the associated uncertainties, and to manage AAS services and make decisions in a way that recognises and works with uncertainty.
2. Build capacity in the monitoring and evaluation (M&E) of adaptation and mitigation, drawing on emerging debates and experience.
3. Build capacity in gender-sensitive approaches to climate change adaptation and mitigation, including collection of disaggregated data along lines of gender and social difference in M&E and impact assessment.
4. Embrace new roles and gain new skills in facilitation, providing advice on probabilities and acting as an innovation broker. This includes influencing other AIS actors and processes to address climate change adaptation and mitigation.
5. Identify new sources of climate finance for AAS providers and other AIS stakeholders, and make these known among stakeholders.
6. Leverage and lobby for funds from public and private sources, including ICT companies, to improve access to, management and use of ICTs to support adaptive management, learning and information sharing to respond to climate change.
7. Facilitate sharing of: information on improving agricultural productivity while supporting other ecosystem services, understanding of ecosystem services in supporting livelihoods, and opportunities and challenges of PES.

8. Facilitate sharing of information on: how market access is changed by climate change for different groups, different types of value chains and business models, which may increase income security and wellbeing, but may also increase vulnerability to market volatility; and new markets emerging in response to climate change, eg, biofuels, carbon markets and new labelling schemes, and their potential pros and cons.
9. Raise awareness of how climate change impacts may overlap with poverty and the methods available to reach the most vulnerable, eg, support for adaptive social protection measures (ie, measures to protect the poor or vulnerable which take into account longer-term risks posed by climate change), such as weather-index crop insurance, asset and cash transfer, seed fairs. Support evaluation of adaptation and mitigation measures from a pro-poor perspective, drawing on emerging good practice in climate change evaluation.
10. Target the youth in AAS and the wider agricultural context as they will be living longer with the impact of climate change and may start to influence decision makers.

Advisory methods

1. Promote and encourage the trend towards learning-based (rather than message-based) advisory methods, eg, farmer field schools.
2. Support mechanisms and platforms for ongoing climate information and knowledge management and learning at each institutional level/scale. Facilitate sharing of experiences and learning through sustainable mechanisms among public, private and third sectors, and across scales, eg, learning alliance approach.

Programmes and projects

1. Identify and highlight features of AAS that are associated with well-run and effective climate-change adaptive programmes and projects. Identify alternatives to project-based interventions.
2. Monitor and reveal the role of or need for adaptive AAS in contrasting kinds of projects, stimulating discussion on and support for organisations and policy makers working on climate change adaptation solutions.
3. Encourage projects to keep in view and in proportion the other drivers of change, which may be of equal or greater importance in changing local societies and environments.
4. Encourage those implementing climate change projects to build on existing institutions and mechanisms, where appropriate, to avoid duplication and fragmentation of effort.
5. Identify where changes are needed in the types of interventions undertaken by AAS and the organisational and policy changes needed to enable them to happen.



1. Introduction

One of the major challenges of the 21st century that AAS have to respond to is a changing climate. The African Forum for Agricultural Advisory Services (AFAAS) is the umbrella organisation for agricultural advisory services (AAS) in Africa and it intends to link AAS to sources of knowledge and innovation to respond to climate change.

AFAAS aims to create efficient, effective and synergistic linkages and partnerships among the AAS of member countries to improve the delivery of these services to farmers. AFAAS operates within the framework of Pillar IV of the Comprehensive Africa Agriculture Development Programme (CAADP), which seeks to enhance the livelihoods of African farmers and pastoralists and is spearheaded by the Forum for Agricultural Research in Africa (FARA). FARA is supporting the institutional development of AFAAS and improving linkages with other umbrella bodies contributing to CAADP Pillar IV. AFAAS aims to directly address the needs of African farmers, contributing to sustainable growth in and transformation of African agriculture, supporting CAADP Pillar IV by providing effective advisory services. It is envisaged that AFAAS Country Forums will enable a wide range of actors involved in agricultural development in each country to exchange information, share lessons, identify potential new services, and innovate on advisory service delivery.

The objectives of this assignment were to:

- Identify what the role of AAS should be in addressing issues of climate change;
- Undertake a study on how different AAS in Africa and countries whose environments are comparable to African countries address climate change; and
- Make recommendations on how AFAAS can begin to promote ways of adjusting AAS to climate change issues.

A review of secondary sources was conducted, covering AAS in Africa, climate change agricultural adaptation and mitigation activities, and climate-relevant policy documents. A number of countries were selected for closer attention, because of the large amount of generic material available in the public domain on agriculture and climate change, the lack of specific and recent information on actual practices of AAS that emerged in early searching, and the limited resources available for the study. Countries were selected to provide coverage of West, East and Southern Africa, and anglophone, francophone and lusophone situations. These countries were: West Africa – Benin, Ghana, Niger, Nigeria and Senegal; East Africa – Ethiopia, Tanzania and Uganda; Southern Africa – Malawi and Mozambique. Preliminary findings and recommendations were shared at the AFAAS Symposium in Accra, Ghana in April 2011.

The report structure is as follows.

- Chapter 2 sets out the linkages among climate change, agriculture and AAS. It introduces the challenges and opportunities for AAS in response to climatic and other drivers of change, and begins to outline the possible roles and characteristics of adaptive AAS.
- Chapter 3 presents the trends and drivers influencing sub-Saharan African (SSA) agriculture and AAS in the light of climate change and other demands on agriculture.
- Chapter 4 provides a review of key trends in African AAS in terms of vision and governance, management, capacity and advisory methods in the light of climate change and the ability to respond. It then provides some examples of current climate change initiatives involving AAS.
- Chapter 5 considers new funding opportunities that are emerging because of climate change pressures.
- Finally, chapter 6 presents some conclusions and recommendations, including how AFAAS may promote ways of adjusting AAS to climate change issues.



2. Understanding the linkages between climate change, agriculture and advisory services

2.1 Key issues in climate change and agriculture

2.1.1 Climate and climate change

It is widely accepted that human activity is increasing the level of greenhouse gases (GHGs) in the atmosphere, causing global warming, which is leading to changes in the climate. The Intergovernmental Panel on Climate Change report (IPCC 2007) states that: *‘Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice and rising global average sea level’* and *‘Most of the observed increase in global average temperatures since the mid-20th century is very likely due to the observed increase in anthropogenic GHG concentrations’*. Definitions of climate and climate change are provided in Box 1.

Box 1: Climate and climate change

‘Climate’ may be defined as the ‘long term average weather’ (IPCC 2007). IPCC defines ‘climate change’ as ‘any change in climate over time, whether due to natural variability or as a result of human activity’.

The United Nations Framework Convention on Climate Change (UNFCCC) definition is ‘a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods’.

Future warming will be determined by natural factors combined with the human impact on future levels of GHG emissions into the atmosphere (and historical emissions to date). These GHG emissions are primarily composed of carbon dioxide (CO₂), methane (CH₄) and nitrous oxide (N₂O). Although most experts agree that warming will continue through the 21st century, and that we are already committed to a certain level due to historical emissions, it is impossible to predict with certainty the precise changes that will occur in the climate for a number of reasons – the complexity of and difficulty in modelling climate systems, limitations in climate data, and the need to make assumptions about future decisions and developments. Various scenarios or storylines have been developed by the IPCC, representing different demographic, social, economic, technological and environmental developments. Even in an idealised situation of GHG concentrations being held to the levels of 2000, it is estimated that global temperatures would still rise on average by 0.6°C by the end of the 21st century compared to the end of the 20th century (IPCC 2007). The best estimate for the low-emissions scenario is 1.8°C and the best estimate for the high-emissions scenario is a staggering rise of 4°C – a change which is thought likely to have catastrophic implications for humanity (IPCC 2007).

Table 1: Sub-Saharan Africa: changes in sub-regional averages of temperature, precipitation and extreme seasons 2080–2099 compared to 1980–1999 from a set of 21 global models for A1B scenario

Sub-region	Temperature (°C)	Precipitation (%)	Extreme seasons (%)		
			Warm	Wet	Dry
Sahel	3.6	–6	100	–	–
West Africa	3.3	2	100	22	–
East Africa	3.2	7	100	30	1
Southern Africa	3.4	–13	100	4	13

Source: Christensen *et al.* (2007).

Note: Data from the IPCC SRES A1B scenario, which assumes a future world of very rapid economic growth, global population that peaks in mid-21st century and declines thereafter, and rapid introduction of new and more efficient technologies. Energy technologies are balanced across fossil and non-fossil energy sources.

Changes in temperature will affect wind patterns, precipitation, frequency and intensity of extreme weather, and sea ice. However, the actual changes will vary significantly by location. Under one scenario of global temperatures rising by 2.8°C, temperatures in SSA are projected to increase by 3.2–3.4°C (Christensen *et al.* 2007). Southern Africa is projected to experience a reduction in precipitation, whereas on average West and East Africa will have slightly higher precipitation. Under this scenario there will be much higher frequency of extreme warmer seasons in all regions, a significant increase in extreme wet seasons in West and East Africa, and a significant increase in extreme dry seasons in Southern Africa. An indication of the projected changes under this scenario is shown in Table 1, although it should be noted that different models show a range of outcomes.

2.1.2 Climate change and agriculture

Agricultural lands¹ are significant on a planetary scale, occupying 37 percent (Smith *et al.* 2008) or as much as 40–50 percent of the Earth’s land surface (Smith *et al.* 2007). Agriculture is particularly vulnerable to climate change, but the sector directly and indirectly is also a major contributor to GHG emissions and hence global warming.

Climate change impacts

The impacts of climate change on agriculture will not be felt evenly. At mid- to high latitudes, moderate warming would benefit cereal and pasture yields, but even slight warming decreases yields in seasonally dry and tropical regions (Parry *et al.* 2007). Further warming would have increasingly negative impacts in all regions.

There are several ways in which climate change may impact smallholder agriculture (Morton 2007; Nelson *et al.* 2010b). Four types of direct impacts can be discerned – impacts on: (i) biological processes affecting crops and animals; (ii) environmental and physical processes, which affect production at the landscape, watershed or community levels; (iii) human health; and (iv) non-agricultural livelihoods. There will also be indirect impacts including: (i) off-site impacts and (ii) impacts of adaptation and mitigation interventions. Table 2 summarises these different types of impacts.

Global food production potential is likely to increase with rises in global average temperature up to about 3°C, but above this it is very likely to decrease. Food and forestry trade is projected to increase in response to climate change, with increased food-import dependence of most

Table 2: Typology of impacts of climate change on smallholder and subsistence agriculture

Direct climate change impacts on smallholder livelihoods	
Biological processes affecting crops and animals at the levels of individual organisms or fields	Direct impacts of changes in temperature, carbon dioxide and precipitation on yields of specific food and cash crops and productivity and health of livestock. Can include impacts of variability in temperature and precipitation, eg, hot or dry spells at key stages in crop development. Also includes changed patterns of pests and diseases.
Environmental and physical processes affecting production at landscape, watershed or community levels	Smallholder agriculture will be affected by direct impacts at the level of communities, landscapes and watersheds (some overlaps with studies on extreme events): eg, decreased availability of water in the irrigation systems of the Indo-Gangetic plain; impacts on soil processes from complex global warming impacts and associated hydrological changes (accelerated decomposition of organic matter, depression of nitrogen-fixing activity), soil fertility and water-holding properties affected, and overall soil erosion exacerbated by increased erosivity of rainfall.
Impacts of climate change on human health	The above impacts on agriculture will be combined with impacts on human health and the ability to provide labour for agriculture, such as increased malaria risk.
Impacts of climate change on non-agricultural livelihoods	Impacts on important secondary non-farm livelihood strategies, eg, tourism, for many rural people in developing countries.
Secondary or indirect impacts of climate change	
Distant, off-site impacts of climate change on a particular smallholder system	Impacts of climate change in other distant areas may create changes which affect a smallholder system. For example, decreased supply of grain in one location might affect specialist cash-crop producers in another area as the latter are net grain buyers.
Impacts of climate change adaptation and mitigation policies, programmes and funds	The secondary impacts of climate change occur as governments, civil society, the private sector, etc., gear up to respond to climate change and institute new policies, programmes and funds – all of which may impact upon smallholders (positively or negatively). An example would be leasing of agricultural lands to agribusiness for biofuel production.

Source: Adapted from Morton (2007, 2010); Anderson *et al.* (2009).

developing countries (Parry *et al.* 2007). Studies suggesting that agricultural trade facilitates adaptation and brings global welfare benefits emphasise the importance of removing trade distortions, eg, subsidies (Huang *et al.* 2010). However, others (eg, Cline 2007) point out that adaptation in developing countries through increasing trade would be severely constrained by limited buying power. The number of people at risk of hunger due to climate change will depend on overall socio-economic development. Smallholder and subsistence farmers, pastoralists and artisanal fisherfolk will suffer complex, localised impacts of climate change (Parry *et al.* 2007).

Modelling the impacts of climate change is complex and there are uncertainties, but a summary of the projections of climate change impacts on agriculture in the African region is provided in Box 2.

A number of uncertainties make estimating the impact of climate change on agriculture challenging (Betts *et al.* nd). These include: CO₂ fertilisation (ie, the crop physiological response to atmospheric CO₂ concentrations and impacts on yields); crop sensitivity (ie, the sensitivity of different crops to local-scale changes in climate); climate model uncertainties (eg, the different emissions scenarios); and regional precipitation patterns (there is less agreement among climate models in projections of regional precipitation patterns than temperature).

Box 2: Impacts of climate change on the African region

Agricultural production: In many African countries and regions, production will likely be severely compromised by climate change and climate variability. This would adversely affect food security and exacerbate malnutrition.

Many livelihoods in African countries, although not all, are reliant on agricultural yields and natural resources. Agriculture is a major contributor to most African economies (averaging 21 percent, ranging from 10 percent to 70 percent of GDP), with indications that off-farm income augments the overall contribution in some countries. Agricultural losses are possibly severe for several areas (eg, the Sahel, East Africa and Southern Africa), accompanied by changes in length of growing periods impacting mixed rainfed, arid and semi-arid systems under certain climate projections. Yields from rainfed agriculture could be reduced by up to 50 percent by 2020 in some areas and locally many people are likely to suffer additional losses when climate change interacts with other shocks and stresses (eg, conflict).

Multiple stresses: climate change impacts will be greatest where they interact with other shocks and stresses (eg, unequal access to resources, enhanced food insecurity, poor health-management systems).

Increases in arid and semi-arid lands: An increase of 5–8 percent (60–90 million ha) of arid and semi-arid land in Africa is projected by the 2080s under a range of climate change scenarios. Declining agricultural yields are likely due to drought and land degradation, especially in marginal areas. Changes in the length of growing period have been noted under various scenarios.²

Pressure on water resources: Current stress on water in many areas is likely to be increased by climate variability and change. Increases in runoff in East Africa (possibly floods) and decreases in runoff and likely increased drought risk in other areas (eg, Southern Africa) are projected by the 2050s. Current water stresses are not only linked to climate variations, but also to challenges in water governance and water-basin management.

Production of lakes: Any changes in the primary production of large lakes are likely to have important impacts on local food supplies – eg, Lake Tanganyika currently provides 25–40 percent of animal protein intake for the populations of the surrounding countries, and climate change is likely to reduce primary production and possible fish yields by about 30 percent. Human management decisions, including over-fishing, are likely to further compound fish off-takes from lakes.

Impacts on ecosystems: Ecosystems in Africa are likely to experience major shifts and changes in species range and possible extinctions (eg, fynbos and succulent Karoo biomes in Southern Africa). Mangroves and coral reefs are projected to become further degraded, with additional consequences for fisheries and tourism.

Sea-level rises: Towards the end of the 21st century, projected sea-level rise will affect lowlying coastal areas with large populations. The cost of adaptation will exceed 5–10 percent of GDP.

Source: Boko *et al.* (2007); Parry *et al.* (2007).

Table 3 outlines the potential impacts of climate change on cereal yields and imports, and undernourished people using four IPCC scenarios (Slater *et al.* 2007). The scenarios make different assumptions regarding future population, economic growth and GHG emission levels. These result in various increases in temperature with associated effects on cereal yields, cereal imports and number of people at risk of hunger. The table indicates the importance of a range of interacting factors that will determine climate change and its impacts.

Climate change, the global food crisis (2007–08) and other issues now facing global development in the 21st century are raising the importance of agriculture in international development, but also leading to greater demands on agriculture. *'Agriculture and global food security have more*

Table 3: Impacts on cereal yields and imports, and undernourished people using four IPCC ‘Special Report on Emissions Scenarios’ (SRES)

	IPCC Scenario			
	A ₁ F ₁	A ₂	B ₁	B ₂
Population in 2100	7 billion	15 billion	7 billion	10 billion
Economic growth	3.5% p.a.	2% p.a.	2.75% p.a.	2% p.a.
Emission levels	High	Medium high	Low	Medium low
Temperature increases (°C)				
2020	0.7	0.59	0.54	0.61
2050	1.96	1.59	1.15	1.31
2080	3.67	2.9	1.76	2.08
Cereal yields (without beneficial CO ₂ effects)	Decreases 10–18% by 2050, up to 30% by 2080 in Africa and parts of Asia	Similar to A ₁ F ₁ ; largest contrast between developing and developed countries		
Cereal imports in developing countries in 2080		430 million tonnes	170 million tonnes	
Number of people at risk of hunger in 2080 with and without CO ₂ fertilisation (million)	136 370	742–885 950–1320	99–102 125	221–244 257–384

Sources: Taken from Slater *et al.* (2007).

Note: many different models were used to process the basic scenario inputs, each using different assumptions.

prominence on the international development agenda today than at any time in the past 30 years. Whether from a production, value chain or human rights perspective, there is a growing concern from governments, agribusiness, farmers’ organisations, civil society organisations (CSOs) and donors to develop new strategies, according to their particular visions and interests’ (Murphy 2011). While there is agreement that there are major global food, agriculture and development challenges that need to be addressed, how the questions around these issues are framed, let alone the types of solutions that could be considered, vary considerably among diverse stakeholders. The framing assumptions are, however, critical in that they shape agendas and steer perceived solutions, programme designs and resources in certain direction, and not others (Brooks *et al.* 2009).

In summarising narratives on small-scale farming, Murphy (2011) provides a useful overview of the range of different perspectives on how agriculture should move forward. In one narrative there is a continued focus on economic growth driven by the agricultural sector and led by agricultural exports, private-sector investment and open markets (which replace government management of the economy). At the other end of the spectrum, a contrasting view supports a more active role for public-sector investment, prioritises local and national markets over global markets, and explicitly emphasises the goals of ecosystem health. A summary of these and other perspectives is set out in Table 4.

Thus, there are different ideas about the potential role of smallholder agriculture in future development pathways. Each option and potential pathway for agricultural development needs to be re-assessed in the light of the challenges of climate change.

Table 4: Summary table of narratives on small-scale farming

	Yesterday's Economy	Agriculture to Reduce Poverty	Room in the Shade	Small-Scale = Good Business	Food Sovereignty and Rights to food
Economic assumptions	Market-based growth One global market Reliance on exports (and insistence on imports) Focus on efficiency as primary value Global value chains (GVC)	Market-based growth One global market Reliance on exports (and insistence on imports) Focus on efficiency as primary value GVC	Market-based growth Niche markets are profitable and plentiful Focus on specialisation and meeting standards GVC	Market-based growth Small-scale farmers are the majority (and plentiful) and so important as consumers and farmers Niche markets are profitable and plentiful Focus on specialisation and meeting standards GVC + production webs	Local markets come first National and regional markets ahead of global Focus on employment & local capital formation Comfortable with government regulation Production webs
Role of government	Minimal : Provide safety net Ensure the rule of law Protect property rights	Minimal, but useful: Encourage partnerships with private sector Ensure the rule of law and private property rights Support organisation of small-scale producers	Important to support small-scale production with appropriate standards Protective regulation Support access to inputs Organising small-scale producers	Unimportant, though support for small-scale initiatives welcome (eg, credit or other input subsidies; procurement contracts; etc.)	Protect, promote & fulfil the universal human right to food (UHRF) + other rights Invest in small producers and local markets Establish and respect democratic processes
Role of donors	Invest in non-agriculture sectors Find pathways out of agriculture Focus on large, industrial farms	Invest in agriculture as a means to an end Work with small-scale producers (top performing 25%)	Similar to government – find ways to support small-scale producers in the market	Support small-scale producers as entrepreneurs	Support governments in their tasks (above) + fund social movements and peasant organisations

	Yesterday's Economy	Agriculture to Reduce Poverty	Room in the Shade	Small-Scale = Good Business	Food Sovereignty and Rights to food
View of small-scale producers (SSPs) & agriculture	Agriculture is mostly irrelevant to a modern economy Aim for <2% employment in agriculture Food should come from industrial producers	Food should come from mix of small-scale & industrial farms in short to medium term Governments should aim at a slow transition to <2% employed in agriculture; see roughly 25% of the current small-scale farmer population as viable	SSPs as a vital and necessary part of agricultural production, but also a minority Focus on entrepreneurs	SSPs are the majority and likely to remain so for some time SSPs as basis of the rural economy Build on the strengths and take into account the needs of SSPs	Agriculture & rural economies are the heart of development SSPs should grow our food Diversity and small-scale over monocrop and industrial-scale production
View of ecology	Not part of economic thinking Overcome through technology ('modern science')	Environment matters but not central	Interest in SSPs providing environmental services	Interest in SSPs providing environmental services	SSPs best managers of their ecosystems Focus on diversity (genetic & technological) Reliance on local knowledge and inputs

Source: Murphy (2011).

2.2 Responding to climate change

Responses to climate change are usually grouped into two main categories: mitigation (addressing causes) and adaptation (addressing effects) (see Box 3 for some IPCC definitions). A brief introduction to adaptation and mitigation in agriculture is provided in this section, together with the integrally linked debate around the multifunctional roles and direction of agriculture.

Box 3: Climate change response: some IPCC definitions

Adaptation: Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, that moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation.

Adaptive capacity (in relation to climate change impacts): The ability of a system to adjust to climate change (including climate variability and extremes) to moderate potential damages, to take advantage of opportunities, or to cope with the consequences.

Mitigation: An anthropogenic intervention to reduce the anthropogenic forcing of the climate system; it includes strategies to reduce greenhouse gas sources and emissions and enhancing greenhouse gas sinks.

Resilience: The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organisation, and the capacity to adapt to stress and change.

Sustainable development: Development that meets the cultural, social, political and economic needs of the present generation without compromising the ability of future generations to meet their needs.

Vulnerability: The degree to which a system is susceptible to, and unable to cope with, adverse effects of climate change, including climate variability and extremes. Vulnerability is a function of the character, magnitude and rate of climate change and variation to which a system is exposed, its sensitivity, and its adaptive capacity.

Source: IPCC (2007).

2.2.1 Adapting to climate change in agriculture

Adaptation can be defined as adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities. Various types of adaptation can be distinguished, including anticipatory, autonomous and planned adaptation (IPCC 2007). Adapting to the weather and climate is a characteristic of all human societies, but climate change is presenting new and increasing challenges.

Adaptation measures are being implemented by a range of public and private organisations through policies, investments in infrastructure and technologies, and behavioural change (Adger *et al.* 2007). Already farmers in developing countries are using their existing experience, knowledge and resources to manage climate risks on their own account and these actions are not easily distinguished from a range of other factors (social, demographic and economic) influencing livelihood decisions and development trajectories (Adger *et al.* 2003). Planned adaptation initiatives are also often not undertaken as standalone measures, but are embedded within broader sectoral initiatives.

Planned adaptation to climate change is moving up the international development agenda (Nelson *et al.* 2008). From an initial focus on top-down analyses of climate change impacts, attention has shifted to vulnerability assessments and more recently to both top-down and bottom-up adaptation planning (eg, National Adaptation Programmes of Action or NAPAs). Subsequently, policy frameworks and tools are being developed to guide adaptation planning, embedding a vulnerability or resilience focus. The previously overlooked interactions between mitigation and adaptation are also receiving greater attention, because of the potential synergies and/or trade-offs implied for policy decisions (IPCC 2007).

Some adaptation interventions focus on generic vulnerability, whereas others seek to specifically confront the impacts of human-induced climate change. In between these two extremes, there are various activities that seek to build response capacity in general or that aim to manage specific climate risks (McGray *et al.* 2007; *see* Box 4).

There will be trade-offs in the options chosen, and these trade-offs are likely to become increasingly complex, with equity implications (Nelson *et al.* 2007). However, there is also the question of how far climate change challenges ‘business-as-usual’ economic models of agricultural development.

In agricultural adaptation, Howden *et al.* (2007) identify the need for changes in technologies or generation of new technologies, but also changes in the broader institutional arrangements.

Box 4: A continuum of development and adaptation				
	Addressing drivers of vulnerability	Strengthening response capacity	Managing climate risk	Confronting climate change
Features	Overlaps a lot with development practice. Activities take little or no account of specific climate change impacts. Examples include livelihoods diversification, literacy projects, women’s rights, HIV/AIDs projects.	Building robust systems for problem solving and capability for more targeted actions. Overlaps with institution building and technological approaches familiar in planned development. Examples include development of robust communications and planning processes, improvement of mapping, weather monitoring and natural-resource management practices.	Climate information integrated in decisions to reduce negative effects on resources and livelihoods (climate change effects not easily distinguished from other hazard effects within the historic range of climate variability). Disaster response planning activities, drought-resistant crops and efforts to ‘climate-proof’ physical infrastructure.	Highly specialised activities exclusively target distinct climate change impacts, falling outside the realm of (current) development. Benefits felt only in the event of climate change. Eg, communities that relocate in response to sea-level risk, and responses to glacial melting.

Source: Adapted from McGray *et al.* (2007).

Farm-level changes will include modifications of farming practices aimed at *maintaining* the existing system, but there may also need to be challenges to broader inequalities, eg, in land distribution, which may be more significant and *systemic* in nature. Changes in governance may be needed to create an enabling environment for adaptation – ie, how to achieve adaptive management (eg, in AAS). In sum, agricultural adaptation can be thought of as modifications to an existing system or a wider set of changes, but in fact both will be required, alongside new approaches and social learning (Howden *et al.* 2007).

2.2.2 The contribution of agriculture to climate change and mitigation strategies

Not only is climate change having an impact upon agriculture, but agriculture is also a significant contributor to climate change. The agricultural sector is a source of GHGs, which contribute to global warming (see Box 5 and Figure 1). Agriculture has the potential to contribute to mitigation through: (a) reducing GHG emissions, (b) enhancing removal (storing or sequestering/capturing) of carbon, and (c) avoiding or displacing fossil-derived emissions through production of biofuel feedstocks.

Deployment of new mitigation practices for livestock systems and fertiliser applications will be essential to prevent an increase in emissions from agriculture after 2030. The most promising options for mitigating GHG emissions in agriculture include (See Figure 2; Smith *et al.* 2008):

- improved crop and grazing land management (eg, improved agronomic practices, nutrient use, tillage, and residue management)
- restoration of organic soils that are drained for crop production, and restoration of degraded lands.

Lower, but still significant, mitigation is possible with:

- improved water and rice management

Box 5: The contribution of agriculture to climate change

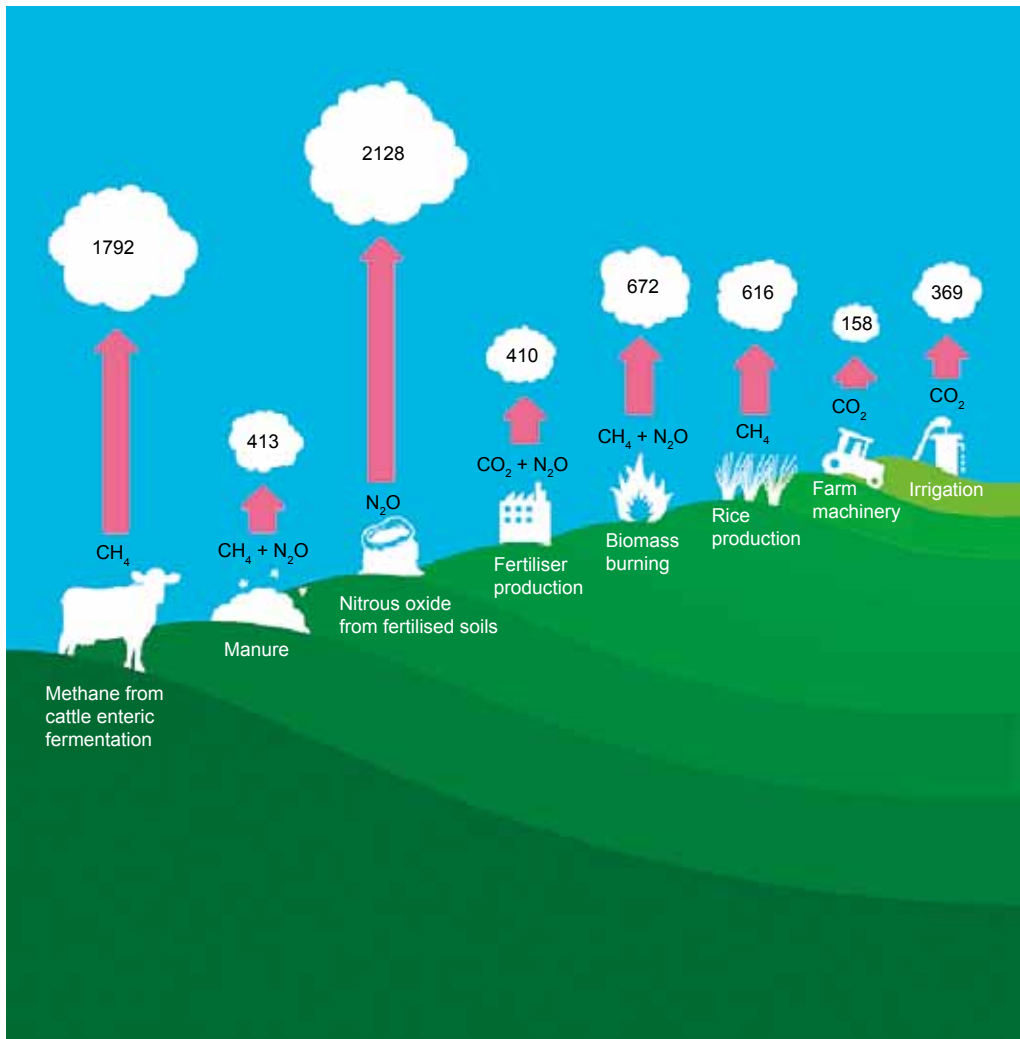
The sector accounted for:

- an estimated 10–12 percent of total global anthropogenic emissions of GHGs (5.1–6.1 Gt CO₂e per year) in 2005, including
- about 50 percent of global anthropogenic methane emissions (in total, methane contributed 3.3 Gt CO₂e)
- about 60 percent of nitrous oxide (in total, nitrous oxide contributed 2.8 Gt CO₂e).

These emissions had increased by nearly 17 percent from 1990 to 2005.

Between 1990 and 2005, the five regions composed of Non-Annex 1³ countries, which are mainly developing countries, showed a 32 percent increase in GHG emissions and were, by 2005, responsible for about three-quarters of total agricultural emissions. The other five regions, mostly Annex I countries, showed a 12 percent decrease in the emissions of these gases. GHG emission rates may escalate in the future due to population growth and changing diets. Greater demand for food could result in higher emissions of methane and nitrous oxide if there are more livestock and greater use of nitrogen fertilisers. The global technical mitigation potential from agriculture by 2030 is estimated to be about 5500–6000 Mt CO₂e. A key determinant of how much of this potential is converted into action is the price of carbon. About 70 percent of the potential is in Non-Annex 1 countries, ie, mostly developing countries.

Source: Smith *et al.* (2007).



Note: Conversion of land to agriculture use adds a further 5900 Mt CO₂e.

Source: Redrawn from Greenpeace International 2008, cited in Seeberg-Elverfeldt 2010⁴

Figure 1 : Sources of agricultural GHGs (Mt CO₂e)

- set-asides, land use change and agroforestry
- improved livestock and manure management.

Many mitigation opportunities are based on existing technologies and could be implemented immediately, but technological development will be a major factor influencing the efficacy of additional mitigation measures in the future.

Soil carbon sequestration offers most of the mitigation potential, with an estimated 89 percent contribution to the technical potential. Mitigation of methane and nitrous oxide emissions from soils account for 9 percent and 2 percent, respectively, of the total mitigation potential (Smith *et al.* 2007). See Box 6 for more information on soil carbon sequestration.

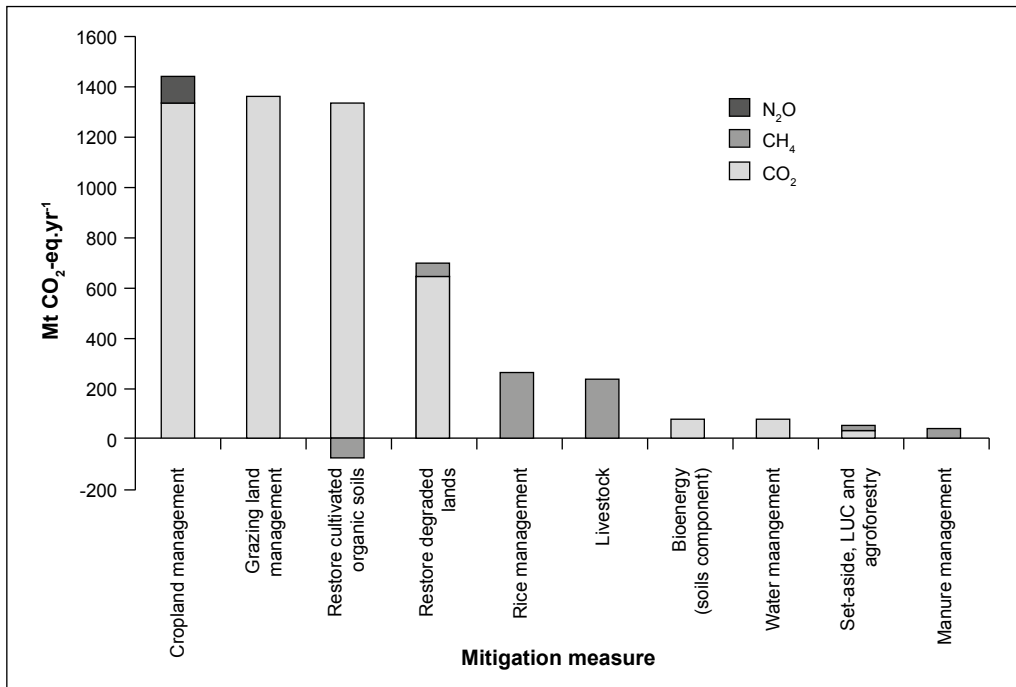


Figure 2: Global biophysical mitigation potential (Mt CO₂e/year) by 2030 of each agricultural management practice showing the impacts of each practice on each GHG stacked to give the total for all GHGs combined (B1 scenario shown though the pattern is similar for all SRES scenarios).
(Source: redrawn from Smith et al. 2008)

Box 6: Soil carbon sequestration

Soils of the world’s agroecosystems (croplands, grazing lands, rangelands) are depleted of their soil organic carbon (SOC) pool by 25–75 percent depending on climate, soil type, and historic management. The magnitude of loss may be 10–50 t C/ha. Soils with severe depletion of their SOC pool have low agronomic yield and low use efficiency of added inputs.

Conversion to a restorative land use and adoption of recommended management practices, can enhance the SOC pool, improve soil quality, increase agronomic productivity, advance global food security, enhance soil resilience to adapt to extreme climatic events, and mitigate climate change by off-setting fossil fuel emissions. The technical potential of carbon sequestration in soils in agroecosystems is 1.2–3.1 billion tons C/yr. Improvement in soil quality, by increasing the SOC pool of 1 ton C/ha/yr in the root zone, can increase annual food production in developing countries by 24–32 million tons of food grains and 6–10 million tons of roots and tubers’.

The strategy is to create positive soil C and nutrient budgets through adoption of no-till farming with mulch, use of cover crops, integrated nutrient management including biofertilisers, water conservation and harvesting, and improving soil structure and tillage.

Source: Lal (2011).

As with adaptation strategies, there is no universally applicable list of mitigation practices – all practices need to be evaluated for appropriateness to individual agricultural systems on the basis of climate, soil-related factors, social setting, and historical patterns of land use and management (Smith et al. 2007; Smith and Olesen 2010).

The price of carbon is a key determinant of mitigation strategies. At low prices, farmers may adjust existing production practices such as tillage, fertiliser application, livestock diet formulation, and manure management. Higher prices are needed to provide sufficient incentives for major land-use changes. Agricultural mitigation measures often have synergy with sustainable development policies. Further mitigation and adaptations in agriculture can overlap, but macro-economic, agricultural and the environmental policies may have a greater impact on agricultural mitigation than explicit climate policies *per se*.

Despite significant technical potential for mitigation in agriculture, there has been relatively little progress made in the *implementation* of mitigation measures. Barriers to implementation are not likely to be overcome without clear incentives and the tackling of other issues, such as capacity strengthening of farmers, AAS and other actors in the agricultural innovation system (AIS).

2.2.3 Agriculture in a changing world

Most studies of AAS or of agriculture and climate change appear to give little consideration to the different pathways that are possible in agricultural development and the narratives, models and visions of agriculture that underpin them. Yet, as explained above, these different economic models and ideas about the roles of smallholder agriculture have to be evaluated in the light of the challenges emanating from climate change – as well as other drivers and pressures. The complexity associated with the drivers and pressures influence agriculture and AAS, and how these are linked to desired and actual outcomes are outlined in Box 7.

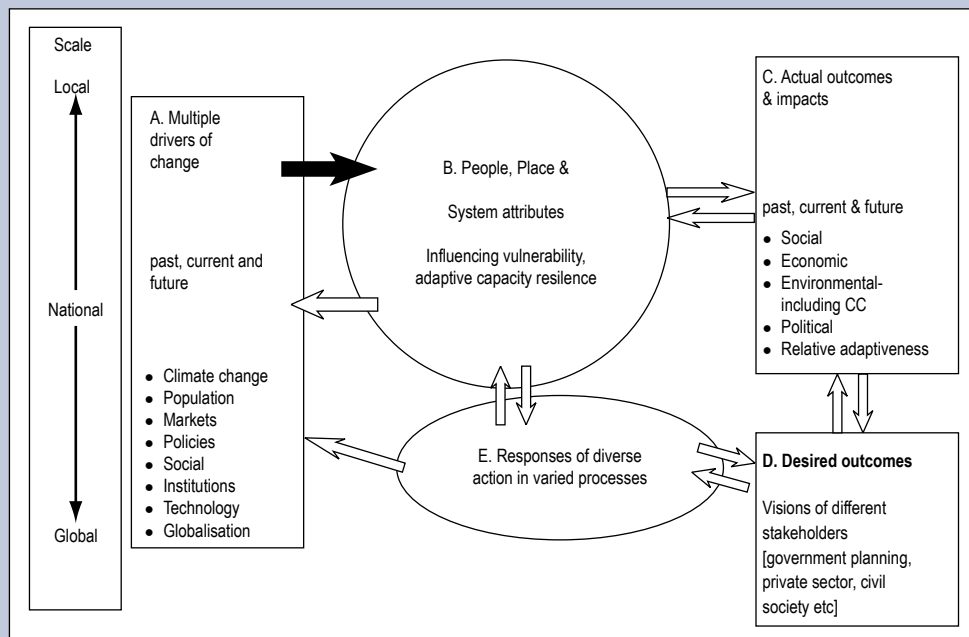
Following a period in which agriculture languished in the development doldrums, interest has reawakened in the role of agriculture as a provider of food and fibre, and other environmental services. This stems from the global food crisis of 2007–2008, increasing acceptance of the threat of climate change, continuing high dependency of the world's poor on agriculture, and the rising awareness of agriculture as a significant contributor to climate change either directly through farming-related GHG emissions or indirectly through forest clearance (Smith *et al.* 2007; Larsen *et al.* 2009; World Bank 2007). Some of the key trends for global agriculture are set out in Box 8.

Some critics argue that many existing approaches seek to control risk and aim for linear innovation and regulation, and fail to address the new uncertainties, risks and (sometimes) opportunities posed by climate change. In many SSA countries, people's livelihoods, poverty and food insecurity are linked to a risky and uncertain agricultural setting, which accelerating climate change will worsen. Despite the use of adaptation and resilience language, many donor and government interventions are unlikely to build up farmers' adaptive capacity in marginal environments. For example, Brooks *et al.* (2009), referring to the situation in Kenya, argue '*In particular, interventions focusing on strengthening and extending the formal maize system at the expense of local, informal systems are in danger of undermining those sources of diversity on which people in different localities need to draw if they are to build livelihoods that are both resilient to shocks and robust in the face of longer term stresses.*'

The diversity and complexity of the changing agricultural context present governments, the international community and other actors with major challenges, opportunities and choices

Box 7: Agriculture in a changing world

This diagram shows the complexity of agriculture in a changing world (Nelson et al. 2008; Stathers et al. in prep.).



Multiple drivers of change. Multiple drivers (A), including climate change, exert influence on a population (eg, village, social group of people), place (eg, rural or urban) or system (eg, agricultural system with social and ecological attributes) (B). These drivers are dynamic, complex, interactive and working across different scales from local to global. These include: population, policies and institutions, markets, and technology. These in turn result in, eg, increasing land pressure, changing consumption patterns, GHG emissions and climate change. Trends include increasing democracy, liberalisation, decentralisation, privatisation, urbanisation and the ‘feminisation’ of agriculture (Heemskerk et al. 2008), as well as the HIV/AIDS pandemic, and several incidences of countries afflicted by conflict.

People, place and agricultural systems. The internal attributes of the population, place or system (B) affect their relative vulnerability, sensitivity, adaptive capacity and resilience to climate change and other pressures. The interactions between the external drivers and the internal attributes lead to actual outcomes, impacts and autonomous adaptations (C). In addition to the heterogeneity among people or households and their assets, vulnerability to climate change is also influenced by exposure to climate-related changes and extreme events and the level of economic development, infrastructure and institutional capacity – all of which are affected by the physical place where the person or household is located. While current and projected climates differ from place to place, so too will the natural resources, eg, soil type and quality, water resources, forests and crops grown, and the services – including AAS – available in different areas and to different households, all of which impact a household’s ability to adapt to climate change.

Actual outcomes, impacts and autonomous adaptations. The interaction between the drivers of change and the population, place or system is the development process. The actual outcomes, impacts and autonomous adaptations (C) can be seen as the results of the development process (eg, changed livelihoods, poverty, wellbeing, inequality or environment). The actual outcomes feed back into the multiple drivers of change in an inherently dynamic, interconnected process involving different scales, landscapes and environmental processes, power relations, time scales and beliefs.

Desired outcomes. Stakeholders’ diverse desired outcomes (D), some more influential than others, inform decisions and responses. Whose desires become reality is largely determined by the governance context (ie, the wider power system in which actors compete for influence). This power system and the negotiations of actors form part of (B).

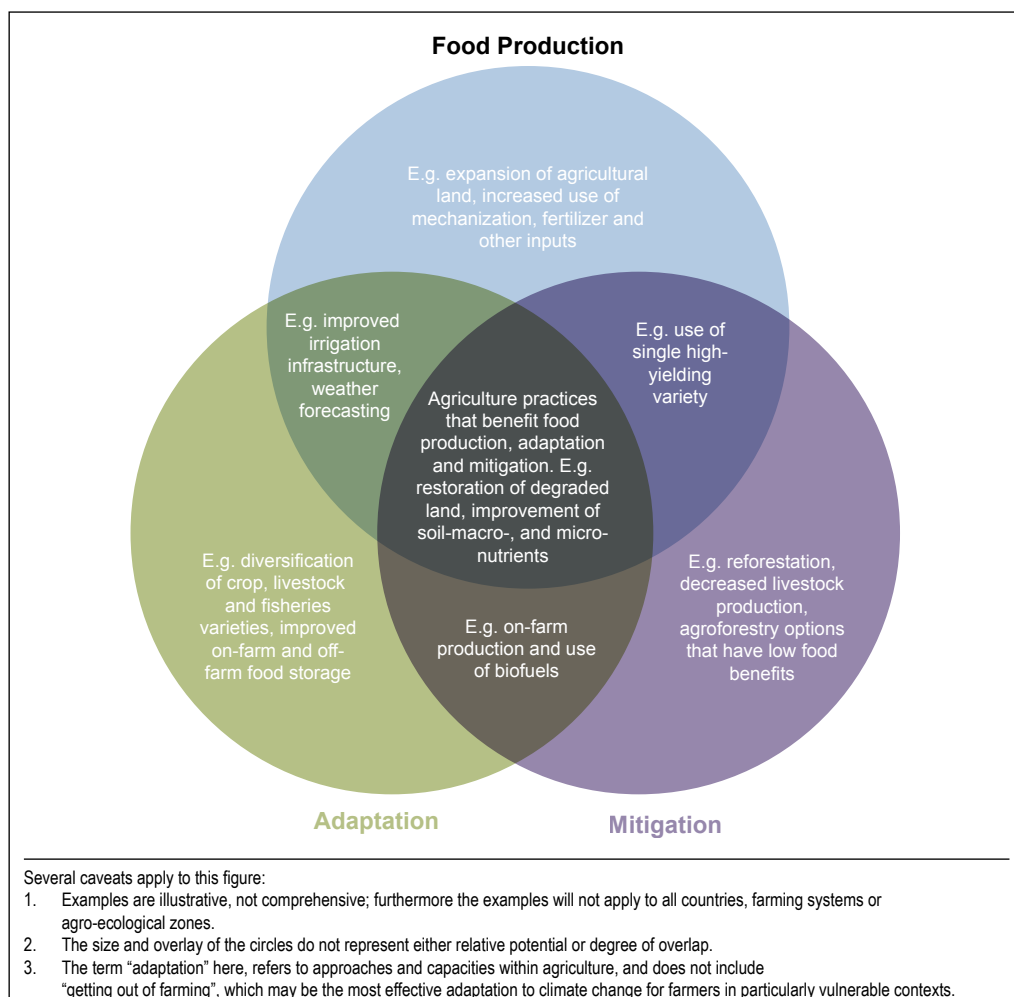
Box 8: Trends for global agriculture	
Trend	Details
Competing demands for agriculture	Increasing complexity of context and greater demands to address food security and other aspects of livelihoods for the rural poor, environmental sustainability, agribusiness development alongside uncertainties of global warming, and new cross-cutting issues such as food safety and biofuels.
Rapidly advancing technological frontiers	The results of public and private R&D present social and economic opportunities, but also raise new questions about a society's relationship with science and the governance of science. Issues range from intellectual property rights to the ethics of genetically modified crops.
Global links	Local production and livelihoods are increasingly connected through international value chains to global preferences, trade standards, national policies and phenomena such as climate change and animal disease outbreaks.
Competitive advantage linked to knowledge application capacity	Innovation capabilities based on accessing, adapting and applying worldwide knowledge are becoming a main source of economic competitive advantage in the 21st century. As a result, country economies can no longer compete solely on the basis of natural-resource endowments, cheap labour, or advantages associated with particular locations.
Increasing pace and non-linearity of change	The global economic network composed of diverse stakeholders is accelerating the pace of change with unpredictable non-linear consequences. Contributing to this dynamic are the more rapid transmission of ideas and the wider set of interactions that the internet now facilitates among technologies, markets and policies.
Networked knowledge	Appreciation that information and technology are no longer located in a single source such as a university or research centre; thus, innovation requires interactive collaboration among various possessors of knowledge, often located at widely dispersed sites.

Source: Larsen *et al.* (2009); World Bank (2007).

concerning the direction of future agricultural development. The '*prevailing narratives of technological change and economic growth have come to dominate key food and agriculture policy debates*', but '*agri-food systems are embedded in complex ecological, economic and social processes, and ... their interactions are dynamic and vulnerable to short-term shocks and long-term stresses like climate change*' (Thompson and Scoones 2009). The solution, according to Leach *et al.* (2010), is to prioritise poverty reduction, to support farmers and others to identify and articulate alternative visions and strategies of agricultural development, strategies that do not simply return to a risk-stabilisation, control-oriented approach, but that foster more adaptive and flexible solutions. The distributional consequences of shifts in agri-food systems should be given greater attention, compared to the current narrow focus on aggregates and averages (Thompson and Scoones 2009). Further, exploration of more resilient and robust pathways should be facilitated in an era of growing risk and uncertainty (Thompson and Scoones 2009) and localised processes of innovation and adaptation enabled. In sum, a key challenge for decision makers is to understand the context and potential adaptive strategies and pathways for farmers and other stakeholders in agriculture in diverse 'rural worlds' (Leach *et al.* 2010) and to consider the implications of different paths of development – AAS have a key role to play in this context.

In the light of climate change and the other demands upon agriculture, a number of potential synergies and trade-offs in agricultural production, adaptation and mitigation can be distinguished (Figure 3; Meridian Institute 2011). Synergies need to be sought, but it may not always be possible to achieve all these goals in each particular place – and this is where governments, farmers and wider AIS actors need to be involved in finding solutions and exploring different pathways.

Figure 3: Potential synergies and trade-offs in agricultural production, mitigation and adaptation (Redrawn from Meridian Institute).



There is increasing recognition that achieving a decoupling of resource use from economic growth is needed (UNEP 2011) by *'improving the rate of resource productivity faster than the economic growth rate'*. However, to achieve this requires a *'massive investment in technological, financial and social innovation, to at least freeze per capita consumption in wealthy countries and help developing nations follow a more sustainable path'*. However, many of the innovations needed to achieve decoupling and low-carbon pathways may actually come from developing countries (OECD 2011).

2.3 Adaptive agricultural advisory services

What should the *new or expanded role of AAS* be in response to climate change and the increasing demands on agriculture?

With respect to climate change, AAS' role may need to include:

- Improving farmers' and other AIS actors' access to and use of weather and climate information – this may include climate science, as well as other forms of climate knowledge (eg, local, indigenous observations and adaptations)
- Analysing the impact of climate change and other drivers influencing farmer vulnerability and resilience in order to plan future responses
- Strengthening farmers' and other AIS actors' adaptive capacity and resilience
- Offering climate mitigation and low-carbon development services to AIS actors.

To fulfil these new or expanded roles, Christoplos (2010b) suggests that AAS will have to develop in three ways:

- **Develop capacity to manage uncertainty:** extension workers move from being 'expert' providers of knowledge mainly from researchers, to providing information, facilitation and advice relating to probabilities and trends. Managing risk and uncertainty requires an improved understanding of climate change, as well as of broader technical, market and social uncertainties. AAS practitioners will need greater capabilities in brokering information, innovating, facilitating and advising on probabilities and trends. More efforts will be needed to explore the possible futures in their locality over longer timescales in planning.
- **Respond to change and unpredictability** by helping farmers live with risk, seize opportunities, adapt and transform livelihoods. This involves being more flexible and adaptive, responding in an integrated manner (eg, bringing together different types of expertise tailored to demand), helping clients live with risk, and enabling farmers to identify and take up opportunities, adapt and transform livelihoods.
- **Embrace pluralist extension systems** in the sense of the diversity of motivations, incentives and orientations of different types of providers (Christoplos 2010b). Roles will vary from focus on production, improving yields, training farmers and technology transfer to facilitation and moving beyond training to learning. Other roles requiring more attention will be supporting farmer organisation, marketing issues, linking to other service providers, and supporting the advocacy activities of farmers.

AAS organisations will need to become more adaptive, ie, they need to be able to adapt to change, but also shape change. There are some key principles of adaptive management that

can be drawn upon in thinking about how AAS might evolve and respond to climate change. 'Adaptive management' is an approach to guiding intervention in the face of uncertainty (Raadgever *et al.* 2008 and Olsson *et al.* 2004, cited in World Bank 2010a). Adaptive-management actions are informed by explicit learning from policy experiments and the use of new scientific information and technical knowledge to improve understanding, inform future decisions, monitor the outcome of interventions, and develop new practices. Mechanisms are established to enable the following:

- Evaluation of alternative scenarios, structural and non-structural measures
- Understanding and challenging assumptions
- Explicit consideration of uncertainties
- Adoption of long-term horizons for planning and capacity strengthening
- Alignment with ecological processes at appropriate spatial scales
- Frameworks for cooperation between administrative levels, sectors and line departments
- Broad stakeholder participation (including research centres and NGOs) in problem solving and decision making
- Legislation is adaptable to support local action and respond to new information.

Adaptive AAS therefore uses an 'adaptive management' approach that involves a shift in roles and outlook. AAS individuals, organisations and systems may be considered adaptive in terms of the extent to which they are:

- Enabling farmers to build up their assets to respond to a changing climate
- Supporting equitable access/entitlement to assets/resources, especially by the most vulnerable
- Supporting farmer self-organisation or agency in the light of climate change challenges and opportunities (eg, finance)
- Enabling technological and institutional innovation at farm and policy levels for adaptation and mitigation
- Strengthening AAS climate knowledge, including supporting and learning from farmer climate knowledge
- Moving towards adaptive management:
 - Base decisions on explicit learning from policy experiments and the use of new scientific information, technical knowledge and farmer knowledge to improve understanding, inform future decisions, monitor the outcome of interventions and develop new practices
 - Longer timescales in planning and capacity strengthening
 - Explicitly addressing uncertainty
 - Evaluating alternative scenarios, and structural and non-structural measures
 - Understanding and challenging assumptions
 - Aligning with ecological processes at appropriate spatial scales
 - Having frameworks for cooperation between administrative levels, sectors and departments (for more integrated approaches).

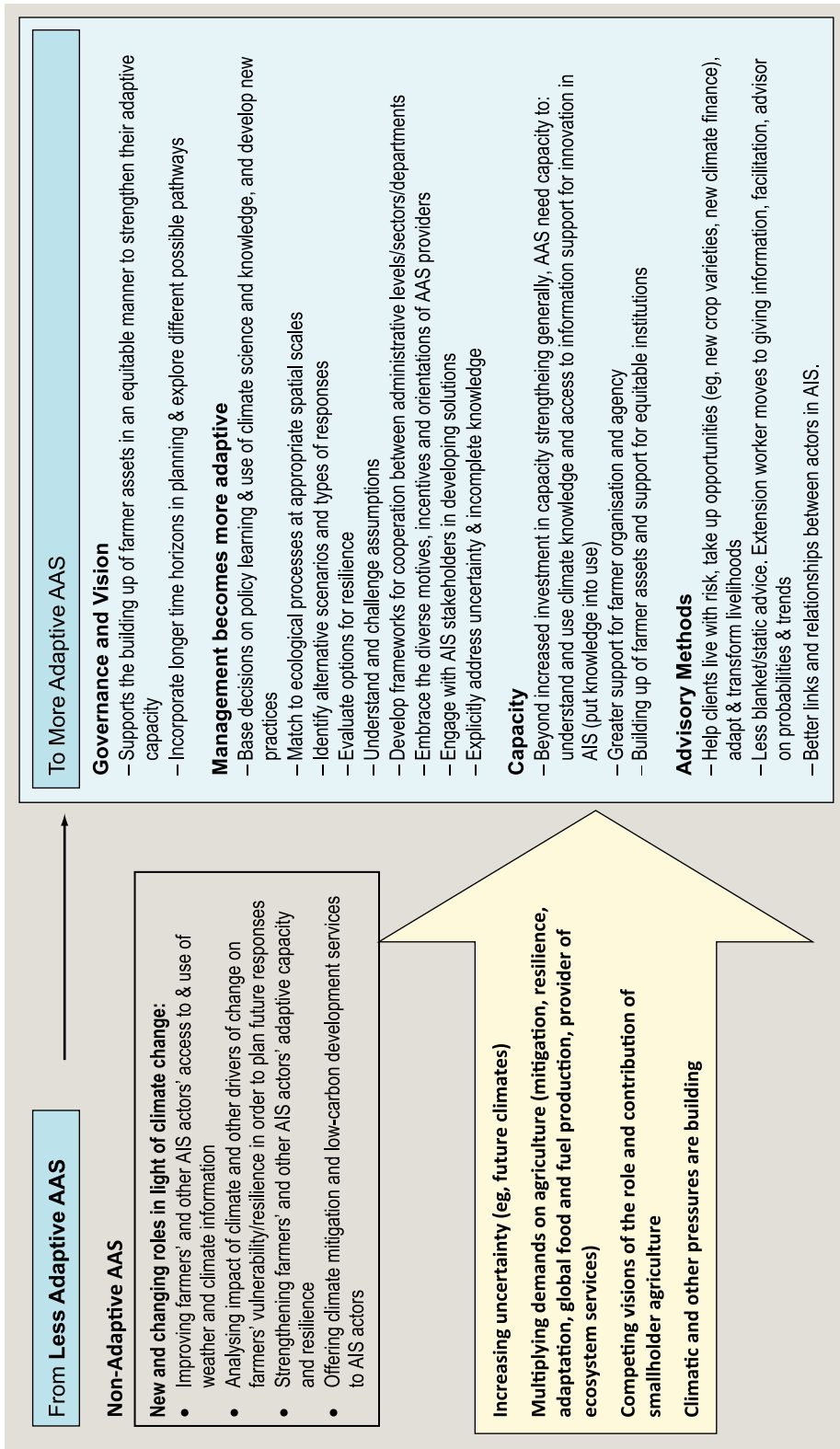


Figure 4: Moving towards more adaptive AAS

To this adaptive AAS approach could be added the concept of resilience (ie, the ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning), the capacity for self-organisation, and the capacity to adapt to stress and change. A resilience check can be applied to proposed adaptation approaches and options, which serves to highlight how far proposals contribute to buffering communities and farmers from shocks and stresses, etc. (Ifejika Speranza 2010). In resilience thinking, the maximising of diversity and maintaining redundancy in a socio-ecological system contributes to resilience – by ensuring that risk is spread and that there are breaks between components of a system preventing system-wide collapse (Walker and Salt 2006).

All aspects of AAS (see Birner *et al.* 2009) including governance, vision, management, capacity and advisory methods may need to change to enable adaptive AAS (see Figure 4).



3. Trends in AAS in the light of climate change and other demands on agriculture

3.1 Evolving roles and trends in AAS

Interpretations of AAS and extension services are diverse (NRI 2010), and have evolved over time. In this section, we discuss these evolving and changing roles for AAS (see Table 5). While debates go on in the policy and practitioner arenas and literature, practice on the ground can be very different.

There is a view that the role of extension has shifted from a service that ‘extends’ research-based knowledge to the rural sector to improve farmer livelihoods (based on technology transfer, broader rural development objectives, management skills and non-formal education) to a role of facilitation, learning and support to farmer groups on marketing and linking to a broader range of service providers and agencies (Davis 2009). Thus, agricultural extension can be defined as *‘the entire set of organisations that support people engaged in agricultural production and facilitate their efforts to solve problems; link to markets and other players in the agricultural value chain, and obtain information, skills and technologies to improve their livelihoods’* (Davis 2009). Interpretations of extension vary from overt political rural campaigning at one end of the spectrum, through commercial promotion of specific commodity production, to the social objectives of promoting and implementing poverty-reduction programmes (NRI 2010). This lack of clarity, as well as top-down blueprint recommendations, lack of flexibility and ability to cater to local requirements, inappropriate technologies for the resource poor and failure to link to market realities, all contribute to the highly variable results seen in terms of impact (eg, in the adoption of recommended practices by farmers, increased productivity or impact on rural poverty) (NRI 2010).

The variable results of extension have led many commentators and studies to question *‘whether national extension services in their traditional form are appropriate and sustainable given the high costs of maintaining these services and the general decline in funding for them’* (NRI 2010). There is now a renewed focus on AAS because of the increasing global concerns regarding food prices and security, agricultural productivity, pressure on land use, climate change, and oil prices and supply.

Other discussions of extension (Swanson 2008; Christopolos 2010b) note the broader range of actors that are already or could be involved in AAS (see Box 6) and the more multi-directional flow of information that could or should influence research programmes and agendas. There is also a much wider appreciation of the range and complexity of stakeholders involved in agricultural development. An AIS approach highlights the range of stakeholders involved and the potential services needed to improve the performance of the AIS.

Box 9: The pluralistic AAS system in Tanzania

Analysis of Tanzania's AAS showed that 51 percent concerned public goods, 41 percent concerned private goods, and the rest was in a mixed public–private domain (such as projects and programmes, including outsourcing). Of these services, 19 percent were provided at the regional level, 41 percent at district level, 18 percent at ward level, and the rest (22 percent) at village level. Most parastatals did not provide services below district level, while NGOs and community-based organisations (CBOs) had a substantive presence at ward and village levels. In 2003, the full cadre of the public extension programme consisted of 1110 district subject-matter specialists (SMSs) and 4725 ward- and village-level extension officers (EOs). These EOs covered 114 districts, 10,470 villages and about 9.4 million farmers. The average farmer-to-public EO ratio was 1970 – approximately one field officer for every two villages. EOs were generally adequately trained to diploma or certificate level, while district supervisors were expected to have a Bachelor's degree. Information from 17 regions and 41 districts identified a total of 290 private or semi-private agricultural service providers (ASPs) of various kinds. The classification was as follows: 39 percent NGOs and CBOs, 31 percent agribusiness companies, 18 percent government and parastatals, and 12 percent donor-supported projects (Isinika 2003). This amounted to at least 10 non-public service providers per region but, through extrapolation from the 41 districts to the entire country, could equally lead to triple that amount. The total number of staff involved in non-public service provision could surpass the number of public EOs.

Sources: URT (2004a), Isinika (2003), Mlozi (2000), and Mlozi and Mvena (2000), cited in Heemskerk *et al.* (2008).

Since the mid-2000s, more attention has also been paid to the capacity of extension organisations, especially the public-sector ones, in relation to their incentive systems, learning capacity, range of expertise (including marketing and farmer facilitation), and relationships with other stakeholders (research organisations, NGOs, private-sector agricultural service providers, etc.) (NRI 2010).

Because of the failures observed in market and state approaches, community-driven approaches have gained prominence. Performance-evaluation studies of selected community-based AAS have been reviewed (Feder *et al.* 2010). The study included the AAS programme of Uganda, the agricultural technology management agency model of India, and the farmer field school approach. The authors conclude that elite capture and the limited availability of competent service providers have been major constraints. Deep-seated cultural attitudes often prevent effective empowerment of farmers, and there are difficulties in implementing farmers' control of service providers' contracts (Feder *et al.* 2010). Just as for the state and the market, communities can also fail in extension delivery, thus the challenge for innovative approaches in AAS is to identify systems that use the potential of the state, the market and communities to overcome the failures inherent in all of them (Feder *et al.* 2010).

Actual changes on the ground have differed widely both between and within countries. In SSA, in particular, various attempts at transforming public AAS through very large interventions have produced variable results. It is increasingly recognised that agencies interested in changing AAS need to take into account all of the key elements of AAS: the context, governance, management and capacity (in its widest meaning), as well as AAS methods (Birner *et al.* 2009). In Figure 5, the left side shows the relevant contextual factors (A to D). The next column shows the main components of an AAS system (governance structures, E; capacity, F; management, G; advisory methods, H). The extent to which the AAS fits with the context is obviously a key indicator of responsiveness and likely effectiveness. The AAS forms part of the wider AIS (which covers many other organisations and actors). The performance of the AAS is indicated by characteristics such as content, targeting, feedback, timeliness, relevance, effectiveness

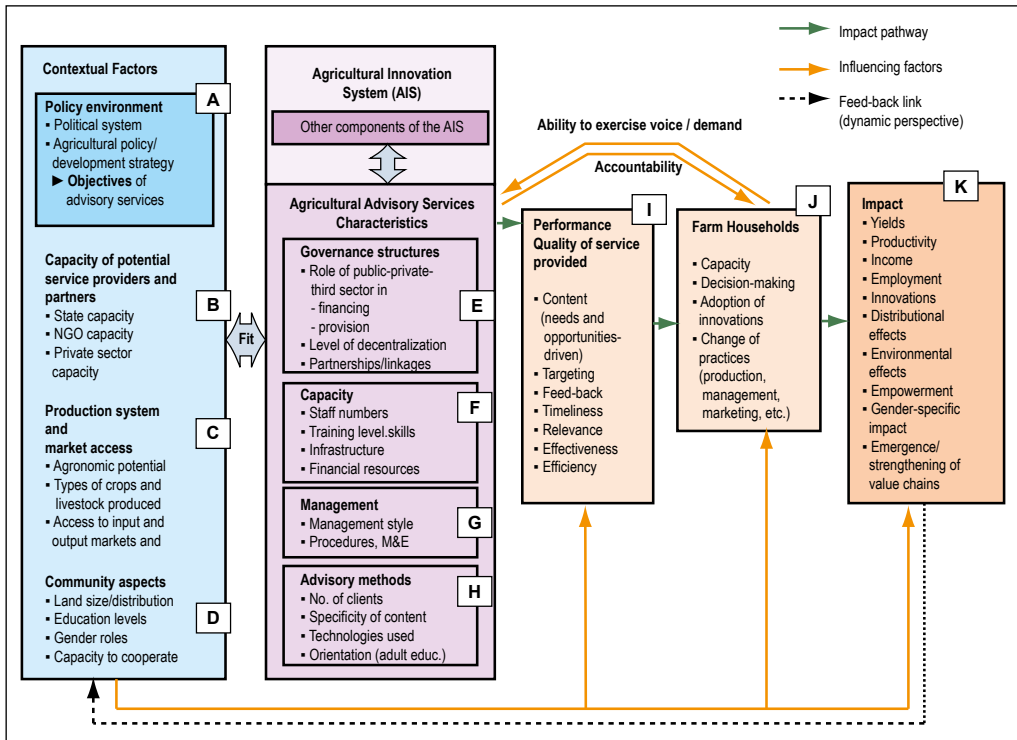


Figure 5: Conceptual framework for analysis of agricultural advisory services (Birner et al. 2009)

and efficiency. The attributes of farm households are also relevant – their capacity, decision making, adoption of innovations, and changes to practices. This then contributes to the ultimate impact of the AAS in its particular context, in terms of changes achieved in yields, productivity, income, employment, innovation, distributional effects, environmental effects, empowerment, gender-specific impact, and emergence/strengthening of value chains. Attribution to different actors in achieving this impact is challenging in any given context, especially in marginal and complex situations, because of the importance of so many other factors in shaping outcomes.

To understand the trends in AAS it is worthwhile looking across these different dimensions:

- Governance processes and structures, which are shaped by dominant narratives about agricultural development pathways
- Favoured advisory methods and the nature of the content of AAS messages
- Capacity
- Management, including linkages to research, and approaches to poverty, gender and social exclusion (drawing from Anderson 2007; Birner et al. 2009).

Table 5 shows the trends relating to interventions in AAS in developing countries. The reality has been a lot more complicated, with considerable overlaps and parallel systems in operation. In terms of the advisory methods used, for example, elements of the ‘from’ situation are set out in Table 7 and are still quite dominant – but there are also pockets or areas of substantial change such as farmer field schools (FAO nd-a).

Table 5: Trends in interventions related to AAS in developing countries

Theme	From	Via	Towards
Overall frameworks			
Overall frameworks guiding thinking and practice in agricultural technology development	Technology transfer/ linear model Research–public extension–farmer	Agricultural knowledge and information system (AKIS) – many actors in a network exchanging	Agricultural innovation system (AIS) Many actors, enhanced role of the private sector, knowledge into use
Governance			
Role of public sector	Public funding Public provision	Reducing the role of the state under structural adjustment programmes (SAPs) Public funding Private provision	Pluralistic public, private & NGO funding and provision of services and advice
Decentralisation	Centralised		Decentralised
Partnerships and linkages	Research–extension– farmer		Diverse partnerships and linkages with actors in AIS
Advisory methods			
Approach	Top-down Message based Model farmers Eg, training and visit (T&V)		Participatory Learning by doing Group based Eg, farmer field schools
Nature of content	Production/ productivity increase and/or sustainable farming		Market-oriented, plus production/ productivity increase and/or sustainable farming
Capacity and management			
Measuring performance	Measuring activities/ inputs		Measuring activities/ inputs, outputs and outcomes
Accountability	Accountable to line managers, funding sources		Public: accountable to clients, ie, farmers or other actors in AIS, line managers and funding sources Private: As above, but funding sources include, eg, shareholders
Use of ICTs	One-way media, eg, radio	Modern ICTs: internet, mobile phones. Sceptics versus over-ambitious interventions	Mobile-phone revolution and increasing access to internet. Limited provision of computer hardware. Potential still being explored
Poverty, gender and diversity	Some targeting of women, but often gender-blind services		More explicit rhetoric on gender- sensitive approaches to AAS, but variable action on the ground

Source: Based on Anderson (2007), Birner *et al.* (2009).

3.2 Context, trends and drivers relating to AAS, agriculture and climate change

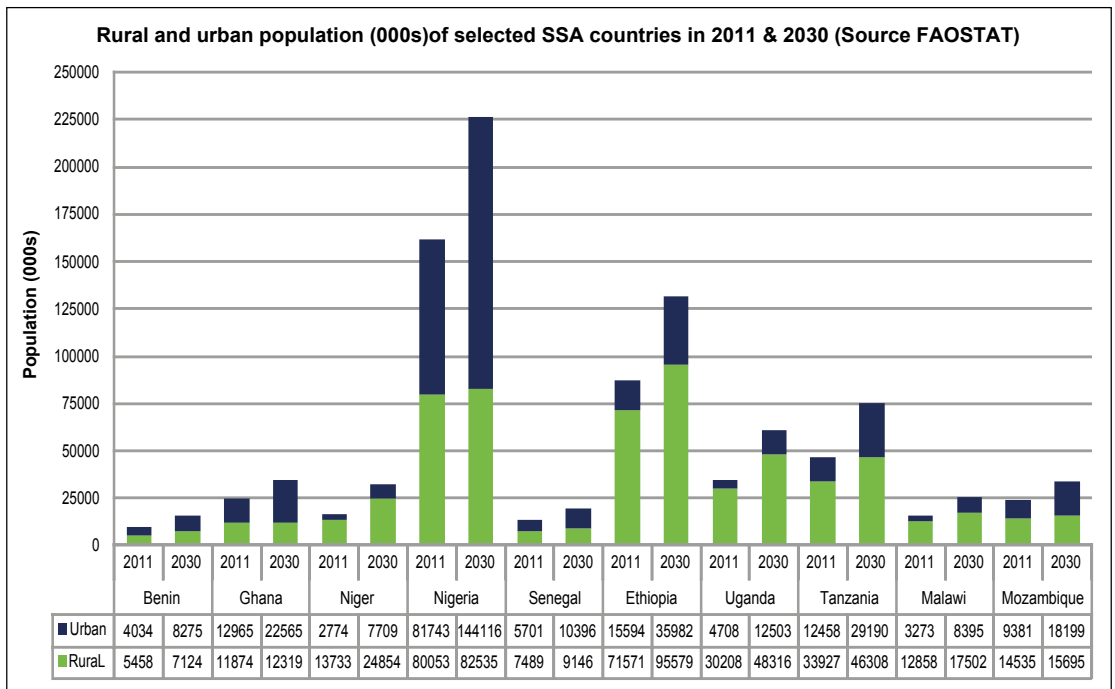
In this section, we review some of the broad trends in SSA rural communities, before analysing some of the agricultural, climate and other policies that have a bearing on the responses of AAS to climate change.

3.2.1 Trends

Population: Africa’s population is projected to double to 2 billion people by 2050, and estimates suggest that globally sustainable long-term food production will need to double in order to meet the basic needs of this increased and increasingly urban population. Figure 6 shows the proportion of populations in rural and urban areas in SSA in 2011 and 2030. Urbanisation is happening rapidly in SSA, but large rural populations are projected for at least another generation. Demographic changes include not only urbanisation, but also increasing migration and seasonal mobility, which may further reduce the voice of rural populations vis-à-vis urban ones.

Figure 7 shows the relatively small area of land under agriculture in Africa, but also the relatively small area under forests. Large areas are under permanent meadows and pastures or other land use. The ‘other’ land category includes large areas where the climate is unable to support rainfed agriculture. Climate change, increasing population and food security, among other factors, are highlighting the importance of the provision of different ecosystem services and the finite nature of these land resources.

Figure 6: Rural and urban population of selected SSA countries 2011 and 2030



Source: Based on data from FAOSTAT.

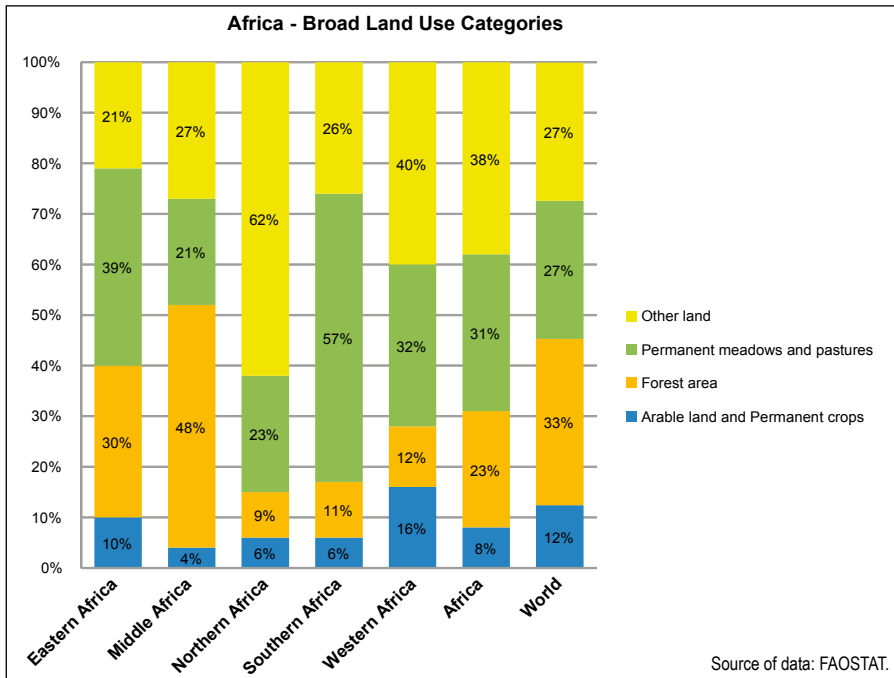
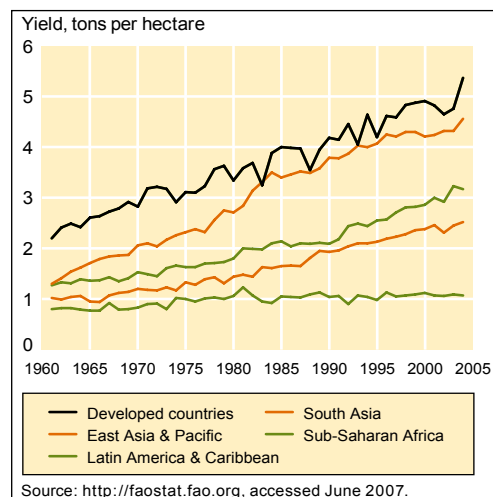


Figure 7: Africa broad land use categories (2008)

Climate change will make it harder to produce enough food for the world’s growing population, and will alter the timing, availability and quality of water resources. To avoid expansion into other ecosystems, agricultural productivity will have to increase, while minimising the associated environmental damage and with net reductions in GHG emissions from food production and postharvest activities (World Bank 2010a; Lybbert and Sumner 2010). This concept of increasing output but using less resources and reducing the environmental impact has been described by UNEP (2011)⁵ as ‘decoupling’.

Crop yields in general have not increased in SSA (see Figure 8) and increases in production have mainly been through conversion of forest and grassland to farmland, with consequent loss of environmental services. Improvements in productivity are therefore crucial, but a conventional high external input approach looks less and less viable in economic as well as social and environmental terms. A number of governments are addressing low use of external inputs by farmers through various subsidy programmes. However, farmers and other actors have limited ability to diagnose locally specific input requirements. Furthermore, locally appropriate inputs are often not available and target groups often do not have access to subsidised inputs. Farm

Figure 8: Average cereal yield by region (redrawn from World Bank 2007)



Input Promotion Africa Ltd (FIPS-Africa; <http://fipsafrica.org>) is trying to address these issues by developing learning protocols that allow farmers to diagnose their own farming constraints (eg, soil fertility, disease), working with enterprises to develop locally appropriate inputs and to make these inputs available in small packs to allow farmers to experiment. There is widespread agreement that improving access to and management of seed and wider agrobiodiversity have a crucial role in strengthening adaptive capacity, but there are different views on the importance of formal versus informal seed systems (see Box 10).

Agriculture continues to play a key role in the economies of most African countries. The sector continues to produce the bulk of food consumed in Africa, accounts for about 60 percent of total employment, and about 20 percent of total merchandise exports and GDP in many countries. It is also the main source of raw material for industry in most African countries. Despite the importance of agriculture in their economies, trade in agricultural products among the African countries remains at a relatively low level. Imports of agricultural products to the continent have been rising faster than exports since the 1970s, and Africa as a whole has been a net agricultural importing region since 1980. Agricultural export patterns in Africa are characterised by a small number of traditional commodities and dependency on preferential access to a few developed-country markets (FAO 2007).

Africa is the only region of the developing world where the regional average of food production per person has not increased since the early 1970s, putting large segments of the population at risk for food insecurity and malnutrition. Although the prevalence of undernourishment

Box 10: Seed systems and agro-biodiversity

Millions of farmers in developing countries access seed from a variety of sources, including their own production; social networks; local grain markets; public-sector organisations and seed companies. Seed systems are often categorised as ‘formal’ (a deliberately constructed system that involves a chain of activities leading to clear products – ie, certified seed of verified varieties; Louwaars 1994, cited in Sperling and Cooper 2003) and ‘informal’ or ‘local’ seed systems (in which seed selection, production and exchange are integrated into crop production and the socio-economic processes of farming communities; Almekinders et al. 1994). By far the majority of seed planted in South Asia and SSA (estimated at 80–90 percent) is from local seed systems (Sperling and Cooper 2003).

There are very different views regarding the contribution that the different components (formal and informal) of seed systems can make to food, income and ecological services. The dominant thinking in agricultural research and development has emphasised short-term yield maximisation through the provision of seed of modern varieties and other inputs, sometimes known as the ‘Green Revolution’ model. This approach brought major productivity benefits in Asia. However, there are trade-offs (UN 2009; Cooke 2010): while modern commercial varieties may raise short-term yields, this is often dependent on higher external inputs and the availability of water. Modern commercial seed varieties may be less suited to farmers’ specific agro-ecological environments – for which landraces may be more appropriate. Finally, the expansion of modern commercial seeds can accelerate crop diversity erosion.

Two key challenges exist: first, formal commercial seed systems should support agriculture to not only raise aggregate yields, but also for the benefit of the livelihoods (food and income) of the most vulnerable farmers in developing countries. Second, informal seed systems also need strengthening because smallholders depend on them for food and income, and because of global long-term food-security issues.

Each system has its strengths and a successful response to these challenges would mean a better balance and integration of the two systems, so that small-scale farmers would have access to both modern commercial seeds and seeds from alternative local systems. Both these objectives can and should be pursued together.

declined from 36 percent in 1979–81 to 27 percent in 2005, the absolute number of people undernourished rose over the same period.

The relationships among trade, climate change and agriculture are complex and there are widely differing views on the subject. Climate change is likely to alter countries' comparative advantages in agriculture, and thereby alter the pattern of international trade (Tamiotti *et al.* 2009). Climate change is also expected to impact infrastructure and transport routes. Countries where climate change creates scarcity may meet their needs by importing and, in the case of food, this is likely to be from mid-high latitude areas (eg, parts of North America, northern Europe) to lower latitudes (eg, much of Africa) (Huang *et al.* 2010). Studies suggesting that agricultural trade facilitates adaptation and brings global welfare benefits emphasise the importance of removing trade distortions (eg, subsidies). However, others (eg, Cline 2007) point out that adaptation in developing countries through increasing trade would be severely constrained by limited buying power. The response to climate change is creating new markets for farmers – eg, biofuels and the carbon market.

3.2.3 The policy context

Liberalisation and structural adjustment policies promoted by the World Bank, International Monetary Fund (IMF) and others in the 1980 and 1990s led to a reduction in state provision of agricultural extension, with the expectation that the private sector would fill the gap. While there is now broad recognition that the state has a greater role to play, this places extra demands on the capacity of the state. *'Meanwhile, most African states are almost two decades into a transition to democracy. Whilst the median voter in most of these states is rural and poor, it remains unclear as to whether democratic politics can generate the incentives for the creation of "developmental" states that will serve the needs of such voters'* (Anon. 2009).

The World Bank/IMF introduced **Poverty Reduction Strategy Papers (PRSPs)** in 1999: (1) to increase domestic accountability for poverty-reduction reform efforts; (2) to improve the coordination of development assistance and governments; and (3) as a precondition for access to debt relief and concessional financing (World Bank Poverty Net⁶). PRSPs outline national macro-economic, structural and social policies and programmes to promote growth and reduce poverty. However, these poverty-reduction strategy (PRS) processes have also been critiqued as promoting a distinctly technocratic approach to development. Donors have promoted these partnerships as being based on mutuality and trust, but a closer analysis of a series of case studies indicates that, as external and domestic political processes intersect, a more mixed picture emerges (Gould 2005). Although language and the social relations of development may change, there is a paradox in that decisive policy-making powers are vested in external agencies in the development of strategies and plans, and this can undermine local structures, ideas and processes of democratisation in developing countries (Gould 2005). The recognition of the link between agriculture, economic growth and poverty reduction has been a major influence on the PRSPs of Africa, including an emphasis on agricultural productivity. *'Agriculture delivers more poverty reduction than other sectors, especially in the lower-income countries, because it has strong links with other sectors and because poor people participate more in growth from agriculture than in growth from other sectors'* (Christiaensen and Demery 2007).

Agricultural visions and policies differ between SSA countries, although the influence of the Bretton Woods Institutions is extremely strong (see Appendix 3). At the regional level, the

agriculture vision of the African Union's (AU) NEPAD is captured under the CAADP, which aims to help African countries reach a higher path of economic growth through agriculture-led development. The CAADP vision is *'Through NEPAD, CAADP addresses policy and capacity issues across the entire agricultural sector and African continent. CAADP is entirely African-led and African-owned and represents African leaders' collective vision for agriculture in Africa. This ambitious and comprehensive vision for agricultural reform in Africa aims for an average annual growth rate of 6 percent in agriculture by 2015'* (www.nepad-caadp.net/about-caadp.php). The programme seeks, by 2015, to achieve more dynamic agricultural markets on the continent, increased farmer access to export markets, but also more equitable distribution of wealth, a strategic role in agricultural science and technology, and environmentally sound production and sustainable natural-resource management.

The stated goal of CAADP is to eliminate hunger and reduce poverty through agriculture, with African governments agreeing to increase public investment to a minimum of 10 percent of their national budgets and to raise agricultural productivity by at least 6 percent. The agricultural productivity theme is therefore strong, but there is no explicit mention of climate change in the CAADP themes. However, a recent CAADP report (CAADP 2010) does refer to regional and country investments on land and water management being supported through the TerrAfrica partnership. This includes the approval of the GEF \$150 million grant for a Strategic Investment Program (SIP) for sustainable land management (SLM) in SSA. This in turn includes a number of operations to scale up climate-resilient SLM practices such as watershed management and land use planning, low tillage, intercropping, agroforestry, small water infrastructure, woodlots, and erosion control that have advanced in different countries.

The visions and policies are fairly consistently based on the premise of increasing agricultural productivity to drive economic growth and poverty reduction. This is being implemented alongside major statements regarding food security. Many countries appear to be juggling the aim of increasing international competitiveness and achieving both economic growth and food security through freer trade and a desire to achieve food security through increasing domestic agricultural production. After years of the state withdrawing agricultural support, many African governments are investing in agriculture, but often with limited articulation of the role of and support for AAS. There is very little explicit mention of climate change in national agricultural policies and strategies. Current policies are generally supportive of agricultural practices that focus on increasing short-term production (eg, expansion of agricultural land, increasing mechanisation, increasing use of fertiliser and other inputs). They are generally less supportive of practices which could improve food production, enhance adaptive capacity and address mitigation (eg, restoration of degraded land, improving soil macro- and micro-nutrients).

Decentralisation is a key plank of development policy in the global South. Full decentralisation (political, administrative and fiscal) leads to integrated planning at the district level and the financing of extension services from the local-government budget, rather than from the agricultural budget managed by the central ministry (Rivera 2001, cited in Heemskerk 2008). Although decentralisation is likely to be important in climate change adaptation, and the trend towards decentralisation is widespread in SSA, the level of success and progress in implementation varies across countries (see Appendix 4 for a summary of decentralisation in several SSA countries).

At the national level, **climate change policies** are emerging, although levels of implementation and coordination between policies vary. Least-developed countries (LDCs) were invited to produce NAPAs, and these were submitted to the UNFCCC between 2004 (Mauritania) and 2010 (Chad), with the majority completed between 2006 and 2008 (see Box 11). Once their NAPAs are received by UNFCCC, the LDCs are eligible to apply for funding from the Least Developed Countries Fund (LDCF),⁷ managed by GEF, and potentially other sources of funding. Non-LDC countries, such as Nigeria and Ghana, are only recently developing national climate change policies. Ghana is developing a National Climate Change Policy Framework (NCCPF) which aims to *'Ensure a climate resilient and climate compatible economy while achieving sustainable development and equitable low carbon economic growth for Ghana'* (Government of Ghana 2010). A list of NAPAs posted by developing countries to the UNFCCC site is given in Appendix 5. Lead responsibility for climate change issues within governments tends to be in the ministry responsible for environmental issues.

Unsurprisingly, given the importance of smallholder agriculture in rural development and poverty reduction, strengthening farmer adaptive capacity features strongly in a number of NAPAs (eg, Mozambique, Tanzania). Action to minimise shocks through measures to protect vulnerable areas including coastal areas and forest land (Senegal), intensify and diversify crop

Box 11: The NAPA situation in selected countries

The Tanzanian NAPA (GoT 2007) recognises the importance of agriculture for the national economy and seeks to tackle the climate change impacts on agriculture, other key economic sectors and on the agrarian population that relies on subsistence agriculture. Fourteen priority projects were identified covering water conservation and management, water efficiency in crop production, alternative farming systems, clean energy sources, afforestation on degraded lands, community forest fire prevention plans, awareness raising on health hazards, sustainable tourism in coastal areas and relocation of vulnerable communities, wildlife extension services, construction of artificial structures to manage climate risks, improvements to land tenure systems, and sustainable settlements.

In the Mozambican NAPA, there is a focus on the effects of extreme weather events that exacerbate existing poverty (MICOA 2007) and four key themes are delineated for action: (i) strengthening of an early warning system; (ii) strengthening producer capacity to cope with climate change; (iii) reducing climate change impacts in coastal areas; and (iv) improving water-resource management under climate change (MICOA 2007). All four are relevant to climate change and AAS. The early warning system will provide information to local communities in a timely and appropriate manner, map vulnerable areas and using local knowledge for forecasting climatic events. The agricultural theme seeks to reduce crop and livestock losses in areas affected by drought, cyclones, tropical storms and other climatic events in the long term, and to increase foodstuff availability in the short term through a range of measures. It also seeks to reduce soil degradation from unsustainable agricultural practices and to reduce degraded areas, as well as establish alternative forms of subsistence and increasing family income (MICOA 2007).

Ghana does not have a NAPA. The Ghanaian National Climate Change Policy Framework (NCCPF) has been formulated by the Ministry of Environment, Science and Technology. The vision of the NCCPF is to *'Ensure a climate resilient and climate compatible economy while achieving sustainable development and equitable low carbon economic growth for Ghana'*. It is supposed to reinforce the strategic objective of the Ghana Shared Growth and Development Agenda (GSGDA) 2011–2014: to foster high and equitable levels of growth going towards middle-income status. To achieve low-carbon growth, climate change adaptation, and social development, seven systemic pillars are identified – governance and coordination; capacity building; research and knowledge management; finance; international cooperation; communication, education and public awareness; and monitoring and reporting.

production through improved water management (Senegal, Benin, Niger, Mozambique), and promote food security (Benin, Senegal, Niger, Mozambique) are prominent elements in the NAPAs.

At least some of the NAPAs highlight the importance of extension or advisory services in adapting to climate change, but also their current limited capacity to respond (see Box 12).

A range of issues has arisen since the formulation of the NAPAs in terms of their implementation – not least the limited funding. Some of the capacity and coordination issues constraining implementation are set out in Box 13.

Beyond the adaptation policies being instituted at a national level, a number of countries have developed Nationally Appropriate Mitigation Actions (NAMA). Voluntary GHG-emission reduction goals are set by developing countries and will be delivered through a combination of technology transfer and financial support from developed countries. It is thought that these are likely to be funded as ‘fast-start’ financing begins to flow (Meridian Institute 2011). Some

Box 12: Examples of the treatment of agriculture in NAPAs

The **Tanzanian NAPA** lists agricultural extension services as one of the existing agricultural adaptation activities. Limited capability of local personnel to effectively analyse the threats and potential impacts of climate change, so as to develop viable adaptation solutions, is identified as one of the key barriers to adaptation.

The **Mozambican NAPA** states that the government is ‘aiming to stimulate production in commercial agriculture and agro-industrial development in rural areas, but the challenge for PROAGRI [World Bank-funded Agricultural Sector Public Expenditure Program Project] is providing sufficient and necessary support to farmers who continue subsistence farming, whilst also supporting a more market-oriented agricultural sector. Agriculture is generally un-irrigated and investments by rural communities are few due to their weak financial capacity. The NAPA therefore calls for investment in agricultural infrastructure, raw materials, the construction and/or rehabilitation of irrigation systems to reduce animal and crop losses in the dry season and to build adaptive capacity’ (MICOA 2007). Barriers to strengthening farmers’ adaptive capacity include: weak involvement of local communities, weak coordination among key stakeholders, delays in allocating funds, lack of access to infrastructure and rural markets limiting buying and sale of agricultural tools and products; a weak network of extension services that can provide technical assistance and technology transfer to the production systems; and a lack of capacity in agricultural research networks limiting the ability to be responsive to the multiple priorities facing agriculture (MICOA 2007).

Box 13: Issues in implementing the NAPAs

Beyond the NAPA document itself, it is worthwhile considering the climate change policy context and governmental responsibilities and capacity to implement policies that are generally climate compatible (across all policies), and to specifically implement programmes and priorities identified in the NAPAs (and equivalent documents).

In **Tanzania**, the NAPA ‘is informed by the aspirations of National Development Vision 2025 for high and shared growth, quality livelihood, peace, stability and unity, good governance, high quality education and global competitiveness’. Tanzania’s economy is largely dependent on agriculture and, therefore, sustainable development strategic actions, both short and long term, must address climate change impacts on agriculture and other key economic sectors. The NAPA was prepared as part of the overall integrated plans, policies and programmes for sustainable development at national level.

In **Mozambique**, disaster risk reduction is already well reflected in most government policy documents and strategies. The Ministry of Environment (MICOA) leads on climate change adaptation and the Institute of Disaster Management (INGC) leads on disaster risk reduction – the latter moving in recent years from a purely reactive and logistical role to a more proactive, strategic sustainable-development approach (eg, with initiatives in semi-arid and arid regions where common staple crops are difficult to grow). Government social protection does not extend to large-scale safety-net programmes as seen in Ethiopia, although there is growing support for social-protection programmes by government and by donors and NGOs, and these are led by the Ministry of Women and Social Welfare. Other governmental bodies active in areas relevant to climate change are the Technical Secretariat for Food Security and Nutrition (SETSAN), which conducts regular surveys on hunger and nutrition, with significant investment in drought-resistant crops and alternative livelihoods in the dryland areas; the Ministry of Agriculture, Food and Nutritional Security, Ministry of Planning and Development, and the National Council for Sustainable Development (CONDES).

Key policy-implementation challenges in Mozambique are said to include: limited implementation due to lack of expertise and knowledge, a shortage of financial resources, weak coordination and lack of funding despite substantial climate change adaptation funding to date; weak coordination and cooperation between ministries on environmental and climate change issues (including competition between MICOA and INCG), and between donors (eg, UNDP and World Bank); lack of civil-society engagement, which is still fairly weak on climate change issues; a focus on hazards, with less attention paid to health, food security and nutrition; and a lack of downscaled climate data (Macaringue 2010).

In **Malawi**, a recent report by ActionAid (2006) finds that there are constraints to implementation of the NAPA, including a capacity gap at the district level, a lack of coordination among sectors, and because the NAPA itself seems to exist in isolation from other sector policies. Smallholders lack knowledge, skills and money to respond to increasing droughts and floods, and current government policies on hybrid maize and privatisation of seed companies have rendered agriculture unprofitable for smallholders.

of the provisions set out and submitted to UNFCCC are directly relevant to agriculture. An example is Ethiopia, which has set out measures in cropland management and agroforestry: they propose the application of compost on 8000 km² of agricultural land in rural communities to increase soil carbon retention, plus agroforestry practices and systems on 261,840 km² of agricultural land for livelihood improvement and carbon sequestration. (For a full list of the agricultural NAMA submissions see Meridian Institute 2011).

3.2.3 Drivers of climate change response

To what extent is concern over longer-term climate change considered to be internationally driven? Many countries are signed up to international agreements (eg, UNFCCC, Kyoto), but at the local and national levels in developing countries there often more pressing concerns about immediate environmental impacts. For example, Thornton and Meena (2010) conclude that: *'Climate change is not yet an organising concept for personal, local or national politics in Tanzania. Whilst individuals may be aware (for instance) that environmental change is taking place their concern is not climate change itself, but what environmental impacts mean for individuals and their families (for instance to their food and water security). Our conclusion is that were it not for the international focus on climate change, the demands of the international climate change architecture, it is unlikely that climate change would yet feature as an issue in the political discourse in Tanzania'*. This may be changing, particularly as increased donor funding is made available to develop climate-compatible policies,⁸ but action on the ground also depends on the outcome of the international negotiations.

In many SSA countries, there has been significant bilateral and multilateral donor involvement for many years, with a great deal of influence exerted over national policy making, including in the realms of disaster risk reduction (DRR), economic policy, and environment. These bodies have now turned their attention to the field of climate change (low-carbon pathways, mitigation and adaptation, etc.). Some have major ongoing programmes across a number of countries – including:

- The **Pilot Program for Climate Resilience (PPCR)** is part of the strategic climate fund, a multi-donor trust fund in the World Bank's climate investment fund. It aims to address climate risks identified in NAPAs and other documents, by strengthening early warning systems; strengthening the capacity of farmers to deal with climate change; reducing the impacts of climate change along the coastal zone; and water-resources management.⁹
- The **Global Facility for Disaster Risk Reduction (GFDRR)** – managed by the World Bank on behalf of the participating donors and other partnering stakeholders – has funded a study on economic vulnerability and disaster risk assessment (2009). The UK Department for International Development (DFID), the Netherlands and Switzerland funded a study on the economics of adaptation to climate change.
- The United Nations Development Programme (UNDP) has been implementing a 20-country **Africa Adaptation Programme**, providing institutional strengthening. In Tanzania, the Japanese are providing funding of \$2.9 million.
- The **Desert Margins Program (DMP)** is a collaborative effort convened by the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) and funded by GEF and a consortium of other funders. It unites nine African countries straddling the desert margins: Botswana, Burkina Faso, Kenya, Mali, Namibia, Niger, Senegal, South Africa and Zimbabwe. The aim is to help these countries arrest land degradation through more sustainable practices and systems that improve livelihoods (see www.dmpafrica.net/aboutus.htm).

In each country, there is now an increasing number of donor-funded climate change adaptation and mitigation programmes, projects and initiatives. For example, in Mozambique there is an active donor coordination group (including Danish, Swedish, Norwegian and Japanese bilateral agencies, and European Union bodies) (Macaringue 2010).

International NGOs are now fully engaged in climate change adaptation and mitigation activities – including some that are partnerships and multi-country initiatives. The projects involved are too numerous to identify and many are still in the early stages of implementation, so evaluation and impact material is scarce. An example of a cross-country programme is the African Climate Change Resilience Alliance (ACCRA) programme, which is being implemented by a consortium (Oxfam GB, ODI, CARE International, and others) in Uganda, Ethiopia and Mozambique. It is developing a local adaptive-capacity framework, building capacity among government decision makers, and seeking to support advocacy on climate change adaptation. ACCRA is only now beginning an evaluation of its activities.

The Climate and Development Knowledge Network (CDKN), a consortium of organisations that seeks to support developing countries to '*deliver climate compatible development through advice, technical assistance, cutting-edge research, strategic knowledge sharing and partnership building*', is funded by the UK government. CDKN recently noted in a blog (CDKN

nd) that there is a new syndrome – Portal Proliferation Syndrome – the rapid expansion of climate information portals and knowledge platforms. In 2011, CDKN organised a meeting of 21 leading climate and development web initiatives to discuss how they could improve collaboration.¹⁰ This reflects the information overload, but also the dynamism of the field of climate change.

Despite this maelstrom of activity, in each of our case-study countries we identified a number of programmes and projects led by NGOs – which have often been ahead of the curve in terms of piloting adaptation practices on the ground with local communities, farmers and with policy makers. In Mozambique, a recent review (Macaringue 2010) found that there are several ongoing projects, including: Save the Children’s floodplain management project (cash distribution of a monthly pension to vulnerable people in Zambezia and Tete Provinces with the Ministry of Women and Social Welfare); the Africa Adaptation Learning programme of CARE International working on disaster risk reduction in Inhambane Province; and World Vision International’s management of climate risk at the community level. In Benin, there is the Strengthening the Capacity to Adapt to Climate Change in Rural Benin (PARBCC) programme; and in Senegal, ENDA-TM is highly active, including the project ‘Linking Climate Adaption’.

4. Characteristics of African AAS and exploration of ‘adaptive’ attributes

In this section, we explore the current features of AAS in SSA in terms of how ‘adaptive’ (ie, able to respond to climate and other change) they are, based on limited accessible information. We analyse vision, governance, capacity, management and advisory methods in public, private and third sectors, and in view of the dimensions of adaptive AAS (see Section 2 and Table 6).

Table 6: Adaptive AAS: Key dimensions and AAS elements – some exploratory questions

	Vision/ objectives	Governance	Capacity	Management	Advisory methods
Dimension		Provision Funding Decentralisation Partnerships and linkages	Resources: human, physical, financial	Top-down v Participatory Rules v results Procedures (eg, M&E) Incentives Organisational culture	Message v learning based No. clients Specificity of content Types of technology used AAS methods, eg, demos, field day
Building up people’s assets to respond to changing climate	Are visions made explicit and how is climate change being taken into account?	To what extent does funding of AAS drive or allow longer- term planning that recognises different ways of strengthening adaptive capacity ?	To what extent is there capacity to explore and respond to different shorter- and longer-term scenarios?	To what extent do management processes recognise an ongoing process of strengthening farmers’ adaptive capacity?	To what extent do methods explicitly address strengthening different farmers’ capacities or asset bases?
Access to and control of assets / Support for equitable institutions	Are equity and associated institutions a priority?	To what extent and how do structures and processes support equitable institutions?	To what extent is there capacity to recognise differing access to and control of assets and foster more equitable institutions?	Do processes reward recognition of differing access to and control of assets by rural people?	Do advisory methods recognise differing access to and control of assets by rural people?

	Vision/ objectives	Governance	Capacity	Management	Advisory methods
Self-organisation of farmers	How is self-organisation by farmers recognised?	To what extent and how do structures and processes support self-organisation?	To what extent is there capacity to strengthen self-organisation by farmers?	To what extent do processes reward strengthening of self-organisation by farmers?	Do methods encourage and strengthen self-organisation by farmers?
Knowledge & information	How are different sources of climate change related knowledge (eg, formal, informal) valued?	How is climate change related information shared among AAS and other actors in AIS?	To what extent is there capacity to access and use climate change knowledge and information?	How is knowledge managed (accessed, used and shared)?	Do methods encourage experiential and shared learning? To what extent is climate change and climate variability being addressed?
Innovation	How is innovation with respect to climate change, agriculture and AAS interpreted?	To what extent and how do structures and processes support localised innovation?	To what extent is there capacity for localised innovation?	To what extent do processes reward localised innovation?	Do methods enhance adaptive, climate change compatible innovation?
Adaptive management	Is adapting to change and shaping change for sustainability a priority?	To what extent and how do structures and processes facilitate adapting to change and uncertainty?	To what extent is there capacity for adapting to change and uncertainty?	To what extent do processes reward adapting to change and uncertainty?	Do methods enhance ability of farmers to adapt to change and shape change for sustainability?

4.1 AAS governance and vision

There is an increasing plurality of actors in both the provision and funding of AAS (see Table 7). The different visions of agriculture underpinning AAS activities in the different sectors are discussed below.

The different funding sources for AAS, which implicitly or explicitly promote different visions of agriculture, also require attention. Public-sector AAS organisations are generally supported by public funds, including national government, multilateral agencies (eg, World Bank, International Fund for Agricultural Development [IFAD]) and bilateral agencies (less commonly). International NGOs and, increasingly, foundations (eg, Bill and Melinda Gates Foundation, McKnight Foundation), through support to projects, are also supporting AAS. In the third sector, international NGOs are generally supported by public donations, as well as donor funding and foundations. National NGOs also receive funding from international NGOs, and donors/foundations. Private organisations mainly use their own funds, but may also access public or other private funds.

Table 7: Options for providing and financing pluralistic AAS

Provider of the service	Source of finance for the service				
	Public sector	Private sector: Farmers	Private sector: Companies	Third sector: NGOs	Third sector: FBOs
Public sector	1. Public-sector advisory services, no fees, different degrees of decentralisation	5. Fee-based public-sector advisory services	9. Private companies contract staff from public-sector advisory services	12. NGOs contract staff from public-sector advisory services	16. FBOs contract staff from public-sector advisory services
Private sector: Companies	2. Publicly funded contracts to private-service providers	6. Private-sector companies providing fee-based advisory services	10. Embedded services: Companies provide information with input sale or marketing of products	13. NGOs contract staff from private service providers	17. FBOs contract staff from private service providers
Third sector: NGOs	3. Publicly funded contracts to NGO providers	7. Advisory service agents hired by NGO, farmers pay fees	11. Private companies contract NGO staff to provide advisory services	14. NGOs hire own advisory staff and provide services free of charge	
Third sector: Farmer-based organisations (FBOs)	4. Publicly funded contracts to FBO providers	8. Advisory service staff hired by FBO, farmers pay fees		15. NGOs fund advisory service staff, who are employed by FBOs	18. FBOs hire own advisory staff and provide services free to members

Source: Anderson (2007); Birner *et al.* (2006: 18, adapted from Rivera 1996 and Anderson and Feder 2004).

Following the 2007/2008 food crisis, in July 2009 the G8 countries¹¹ pledged \$22 billion to support agriculture, reversing a long period of declining support (Murphy 2011). Decisions regarding financing and provision of AAS are driven by the visions and beliefs of decision makers at all levels.

4.1.1 Public sector

In the public sector, the focus is generally on increasing productivity to drive economic growth, poverty reduction and address food security. Postharvest issues and value addition are starting to gain more attention. An explicit poverty focus is also becoming more prominent (eg, in Tanzania, Mozambique). Environmental issues and addressing climate variability have also gained greater attention in recent years, but climate change only started to emerge as an issue very recently.

Public-sector vision and objectives follow government policy (see section 3.2.3). There are a few examples of public-sector longer-term visioning (eg, Vision 2025 in Tanzania), although

there may be only be limited capacity (eg, access to information) to do this in a well-informed way. Public-sector AAS organisations could potentially have greater influence over the design of policies and regulations, but currently tend to follow rather than set policies. Decentralisation may create more opportunities to influence local policies and regulations (eg, District Agricultural Development Plans in Tanzania). Decentralisation offers the potential for more equitable institutions, but this depends on context.

Government policies often include the aim of strengthening farmers' capacity for self-organisation, but ultimately this may be considered a political threat – eg, the Cooperative movement in Tanzania in the past.

There is some evidence of awareness of climate change issues and clear demand for knowledge (eg, personal experience of authors in many SSA countries and confirmed in the AFAAS meeting in Accra in April 2011). Climate change issues are being given higher priority in some countries (eg, Senegal, Benin) depending on the perceived threat to future capability, competitiveness in markets, domestic growth and welfare.

4.1.2 Third sector

There is divergence in the ethos and underlying visions among third-sector organisations (NGOs, CBOs, farmer organisations), with diverse objectives, activities and funding sources. Some emphasise conservation objectives, but others prioritise broader environmental interventions, while others have more of a social-justice and social-development orientation. Of the latter, some are more rights-based than others that concentrate on income generation, food security, and organisational development. Most NGOs would support a strong role for smallholders in agriculture (Table 4, page 19).

A number of international and national/local NGOs have major climate change objectives and have formed partnerships primarily for advocacy purposes, but are also implementing and developing approaches to respond to climate change – in both mitigation and adaptation. Gough and Shackley (2001) identify three broad styles of engagement through which NGOs contribute to the climate change debate: (i) developing creative policy solutions; (ii) knowledge construction; and (iii) lobbying or campaigning. Biermann (nd) suggests that the role of local NGOs in fostering adaptive capacity is largely not assessed, but there are now many examples of projects being implemented on the ground. For example, in Senegal, the National Council of Cooperation and Rural Agreement (CNCR), which promotes the interests of more than 20 member associations (including farmer, livestock and fisher organisations), is now including climate change issues in its advocacy and development work (CNCR 2011). The project Recherche Interdisciplinaire et Participative sur l'Intégration de Microorganismes dans les Systèmes Agricoles en Afrique de l'Ouest dans le contexte de Changements climatiques (RIPIMSA) is conducting interdisciplinary and participatory research on the integration of micro-organisms in farming systems in West Africa in the context of climate change – this project engages rural people and other stakeholders in developing ways to benefit from nitrogen-fixing bacteria as a climate change response in Senegal, Mali and Niger (CNCR 2011).

In the late 1980s and 1990s, there was a 'boom' in the NGO sector, with a proliferation of organisations and an increase in the scale of their activity. In developed countries, the Organization for Economic Co-operation and Development (OECD) estimates that the number

of Northern NGOs engaged in international programmes rose from 1600 to 2500 between 1980 and 1990. Although estimates are not reliable in developing countries, there are also over 250,000 Southern NGOs (Guler 2008). There was also a growing sophistication, professionalisation and, in many cases, internal decentralisation of international NGOs in the 1990s and 2000s. Many NGOs focus on rural development, given their central poverty focus and spatial patterns of poverty in developing countries. NGO climate change adaptation programmes (eg, those of Oxfam, CARE, Practical Action, IDID Benin) have often been ahead of the curve in terms of piloting community-based adaptation projects on the ground, many of which involve farm-level innovations. A number of NGOs are currently piloting mitigation initiatives (eg, World Vision, Farm Africa, VI Agro Forestry).

In Tanzania, the Rungwe Smallholder Tea Growers Associations (RSTGA) comprises smallholder farmers who own individual farms with an area ranging from 0.25 to 2 ha (Kamuzora 2011). Previously, these farmers sold their tea through the Rungwe Tea Cooperative Society (RUTECO). In 1998, as privatisation policies were implemented, Rungwe farmers founded RSTGA as a new NGO, as they were dissatisfied with the existing cooperative structure. With RSTGA, a completely new governance structure was introduced. In 2007, the Rungwe district had a population of approximately 307,000. RSTGA had approximately 15,000 members growing tea in 114 tea villages. These 114 villages were, and still are, hierarchically organised in 14 tea sub-schemes, which in turn are taken up into nine tea schemes. These tea schemes form the Rungwe Tea district. The Tea Research Institute of Tanzania – formerly in the public sector, but now privatised – has a formal contract with Wakulima Tea Company (WATCO) to supply AAS to tea growers.

4.1.3 Private sector

The visions of smallholder agriculture in the private sector vary according to which smallholder narrative they subscribe to (see section 2 and Murphy 2011). Beyond profit, there are other motivations which may drive different types of companies and individual managers, such as reputation management, as well as philanthropic and ethical motivations. Corporate Social Responsibility (CSR) and public relations are already influencing the response of individual companies in relation to climate change. Public-goods-related activities in adaptation are happening through CSR, research and social enterprises, public–private partnerships or not-for-profit engagement by the private sector – eg, disaster management (Deutsche Post), conserving forests (Ricoh) and water conservation (Suntory) (Harsdorff and van der Ree 2010). However, government leadership and clear, coherent policy frameworks have been lacking and this has meant that private-sector investment has not been on the required scale (Harsdorff and van der Ree 2010). Further, emerging experience and useful networks are not sufficiently visible and accessible (Harsdorff and van der Ree 2010). *‘Once a transparent and reliable regulatory framework is operational, the private sector may be more willing to build on and complement the efforts of the public sector in order to help enable a strong and effective response at national and local level. The unique expertise of the private sector, its capacity to innovate and produce new technologies for adaptation, and its financial leverage can form an important part in the partnership that is required between governmental, private and non-governmental actors’* (Harsdorff and van der Ree 2010).

Climate change mitigation imperatives (reducing GHGs) have led to opportunities for the private sector, eg, in carbon trading and liquid biofuels for transportation. Mandatory targets

set by industrialised governments have contributed to the 'biofuel boom', encouraging investment, but also raising serious concerns about the social and environmental outcomes for rural communities and regions. For example, the Malawian company Bio Energy Resources Ltd '*was established in 2006 with the sole purpose of developing bio-energy production on a commercial basis within a sustainable framework. BERL is promoting planting of Jatropha curcas as feed stock for the production of biofuel*' (www.berl.biz).

The responses of diverse private-sector actors to climate change in agriculture in SSA are given in Table 8, which maps out their different roles in the AIS. The main actors include: (i) those providing inputs to farmers (eg, seeds and agro-chemicals); (ii) producers of seeds and agro-chemicals (eg, Syngenta); (iii) large-scale growers (eg, tea estates, cut-flower farmers, vegetable producers) who may also buy from and provide advice to out-growers and the processing and trading companies that link to smaller farmers; (iv) independent private service enterprises that provide training and advisory services to farmers directly or at the behest of another actor; and (v) large multinationals that are not engaged in agriculture directly, but may implement large-scale CSR programmes that include provision of AAS.

Independent private service enterprises (Table 8, column 4) provide AAS to farmers and may be paid directly by farmers or by others. The original National Agricultural Advisory Services (NAADs) model in Uganda is an example of the private sector providing services to farmers – paid for by public funds. Private companies may also work on behalf of other companies such as A-tripleT, which provides AAS to tobacco growers in Tanzania paid for by another company – Alliance One Tanzania Limited (AOTL) and Tanzania Tobacco Leaves Company Limited (TLTCL).

Multinational companies (Table 8, column 5) may have non-agricultural core business operations (eg, the extractive industries), but may be undertaking CSR investments and partnerships that affect rural development (eg, infrastructure investment). On occasion, they work directly with farmers or fund others to provide AAS. In Nigeria, oil companies are, at the request of the government, developing agriculture within their concessions in the Niger Delta region (Ogunlade *et al.* 2009). Agip Green River and Shell Petroleum Development Company (SPDC) are two examples of organisations providing agricultural services to farmers on behalf of oil companies.

There seems to be increasing interest from growers, traders and processors of export commodities in terms of responding to climate change. For example, ECOM Agroindustrial Corporation (a processor and merchandiser of coffee, cotton and cocoa) is working with Komothai smallholder farmer cooperative (9000 members) in Kenya. The aims are to restore coffee production (eg, shade trees, improved use of fertilisers), reduce farmers' vulnerability to climate change, produce certified coffee, and sell carbon credits (Tennigkeit and Woelcke 2009).

One example of a supplier that works with out-growers, buying their crops for export, is Katani Ltd in Tanzania. This company supports out-growers to produce sisal – a crop which many consider climate resilient. It thrives well in drought conditions or heavy rain and can survive in marginal land. Planting or harvesting of sisal can be done at any time of the year. The mature plant can be left for more than 12 months without affecting the plant or the quality of the harvest. Sisal fibre can be stored for over 5 years without affecting its quality. It suffers no postharvest losses (www.katanitz.com).

Table 8: Characterising commercial private-sector AAS providers

Dimension	Input suppliers	Seed & agro-chemical companies	Large-scale growers (that may also be linked to out-growers) or processing and trading enterprises	Independent private service enterprises	Multinational companies not directly engaged in agriculture (eg, extractive industries)
Activities	Supply seeds, livestock, agro-chemicals, animal feed, veterinary medicines and equipment to farmers. Often small scale	Producers of seed, fertilisers, etc.	Processing and trading enterprises	Range from individuals and small firms to larger training and resource institutions	High-profile companies
Incentive/ interest in providing AAS	Provide advice to increase farmers' production and uptake of their products	Provide advice relevant to products that farmers are growing and marketing to increase demand for input supplies (eg, Syngenta)	Aim to secure quality and quantity of produce at the right time from their suppliers. These services often require a high degree of specialisation and are usually embedded in contract farming arrangements and other business transactions	Provide AAS for farmers, or at behest of other actors such as processing and trading firms, or public funding agencies	CSR and public relations
Main source of funding for AAS	Use own funding, and from seed & agro-chemical companies	Use own funding	Use own funding	Farmers pay for services, or processing and trading enterprises pay for services, or public funding agencies	Use own funding
Clients	Farmers are the customers	Input suppliers are the customers, or farmers	Farmers and other actors in their value chain	Farmers and other actors in AIS	

There is increased scrutiny of the social and environmental conditions of production and trade of products sourced from developing countries for sale in developed countries. Media reports and NGO campaigns have forced some multinationals to address their CSR and this has led to the development of corporate codes of practice, benchmarks and private standards and labels.¹² CSR is also of interest to some national companies based in developing countries, such as India. Awareness is growing of the potential reputational benefits of CSR. Climate change mitigation imperatives are already on the agenda of many companies. In the East African horticultural and floricultural industries, which are already highly codified, climate change market demands such as carbon or water labelling are seen as just the next market requirement by the supplier company's management.¹³

Social and environmental certification involving consumer labels has also grown with a rising market share – although still fairly niche. There has been a proliferation of standards being applied to agricultural commodities (eg, Fairtrade, Rainforest Alliance, Forest Stewardship Council, and Organic Agriculture). Standard systems have diverse origins (eg, industry led or civil-society led), ethos, primary vision and objectives, approach, and the particular requirements or content of their standards. Fairtrade has moved into the mainstream in recent years with large retailers selling ‘own brand’ certified products in supermarkets, as well as the more niche Fairtrade products from alternative ethical traders. Fairtrade organisations and producer groups are beginning to respond to climate change imperatives – in adaptation and mitigation initiatives and involving value-chain partners such as retailers that invest to secure their supply chain. The Fairtrade Foundation has commissioned a report focused on public communication on climate change as well as a more in-depth study of the implications of climate change for Fairtrade-certified agriculture (Nelson *et al.* 2010b). The latter study identified a range of entry points for Fairtrade organisations to respond to climate change. Other alternative-trade organisations, such as Twin Trading and CaféDirect, are implementing climate change adaptation pilot initiatives (eg, with coffee producers). The global association for social and environmental standards, a body that represents sustainability standards – the ISEAL Alliance – is also developing guidelines for standard systems on adaptation.

A whole new raft of climate market mechanisms is emerging aimed at carbon mitigation, including carbon labels on products for consumers (see Nelson *et al.* 2010a) and standards are beginning to integrate climate modules and criteria into their existing standards as well (eg, Rainforest Alliance recently launched an add-on voluntary, climate module). The Climate, Community and Biodiversity (CCB) standard has a voluntary set of criteria on climate adaptation, additional to their main standard which already incorporates carbon-sequestration elements – offering a ‘gold standard’ if achieved.

Private-sector adaptations undertaken at the national or local scales may be relatively invisible, because they may be small scale, short term or are just not communicated (Harsdorff and van der Ree 2010). There are, however, many examples of investments that could be considered adaptations, such as: water harvesting in community infrastructure investment, retrofitting in the building sectors, erosion control, improving business infrastructure or upgrading skills/local entrepreneurship (Harsdorff and van der Ree 2010). It is not clear how many of these investments are being undertaken already – they are mentioned because they contribute to building adaptive capacity. It is equally unclear how far they are *additional* activities, or how far they are based on an informed view of climate change. There is very limited information available on developing-country private-sector company climate change responses. This may be due to a lack of capacity and motivation to share. It may also be because this information or innovation may have commercial value which companies can use to set themselves apart in the market as ‘thought leaders’, gaining reputational benefits or because they represent new economic opportunities that if shared would lead to greater competition.

Some private-sector activity undermines the local adaptive capacity of communities and environments in developing countries. For example, large-scale plantations established to produce liquid biofuels for transportation can lead to land dispossession among smallholders, and can contribute to offsite deforestation and potentially exacerbate food insecurity. Some analysts suggest that corporates should seek to become more sustainable, through a more

in-depth transformation of core activities and make commercial capital out of sustainability opportunities. These opportunities are likely to become greater over time as more efforts are made to achieve decarbonisation of economies.

Focusing specifically on adaptation in the private sector, four primary drivers for action can be identified. First, some companies or individuals perceive the need to implement measures in response to projected physical impacts of climate change (eg, of droughts), such as a water-harvesting systems. Second, the actions of other companies may spur a particular company to act (eg, competition to develop drought-resistant new crops). Third, changes in consumer demand may play a critical role (eg, for new climate-proofed buildings and devices such as air-conditioning). Fourth, policy and regulatory changes might encourage a company to undertake mandatory tree planting for erosion control (Harsdorff and van der Rees 2010).

Many companies are outlining a business case for action on climate change and are exploring changes that can be made within their core business operations (UNFCCC nd). The types of private adaptation actions undertaken can also be categorised: (i) new climate change induced investment; and (ii) establishment of new businesses from private adaptation investments such as offering of new services and products. So enterprises, farmers and households in flood- or drought-prone areas may privately invest in new crops and/or climate-proofed buildings, may take up insurance or relocate. Private companies may create new businesses having invested in new climate-resistant crops or new water-purification technology (products). They may offer insurance schemes, agricultural extension or water and sanitation infrastructure (services). As well as developing completely new products and services, they may simply adapt existing ones (Harsdorff and van der Rees 2010). Quite often public institutions provide ‘soft’ adaptation measures (capacity strengthening, awareness raising, public health services and training) and may contract private enterprises to undertake ‘hard’ engineering adaptation.

There are a number of barriers to private-sector investment in climate change adaptation, including (after Harsdorff and van der Ree 2010):

- The public good character of adaptation benefits;
- Piecemeal investments by the private sector do not align with national programming;

Box 14: Examples of private adaptation products and services

Products

- Water-desalination technology or portable water-purification systems, such as SkyHydrant developed by Siemens
- New dyke systems developed by BASF also fall under this category

Services

- Insurance (Munich reinsurance, Allianz)
- Research (Veolia Environment Institute, McKinsey)
- Government and management systems, such as in REDD (Cisco Systems)
- Private agricultural extension, weather services and insurance (Sompo Japan Insurance)
- Business development services
- Water and sanitation services
- Infrastructure

Source: Adapted from Harsdorff and van der Rees (2010).

- Enterprises with the largest externalities are located in the global North, whereas the need to adapt is felt more acutely in the global South;
- Lack of resources of public institutions in developing countries to undertake both soft and hard adaptation measures;
- Need for more sharing of best practice, awareness raising and guidance materials, promotion of business opportunities and identifying what constitutes an enabling environment (policy, institutional, legal and incentive conditions) to facilitate private-sector investment.

4.1.4 Summary discussion: AAS vision and governance

Production-innovation and growth narratives are fairly strong narratives that frame future visions of agricultural development, but these may not be appropriate in all situations, and do not always deliver sustainable and equitable outcomes – particularly in marginal environments and in view of progressive climate change challenges. A greater diversity of future pathways should be explored. Agricultural policies need to balance synergies and trade-offs in seeking to achieve the multiple objectives placed on agricultural systems (food production, adaptation, mitigation, etc.) – but prioritisation may be necessary at the national and sub-national levels, where all three objectives cannot be met simultaneously and decisions should reflect biophysical and socio-economic contexts, climate change impacts, agricultural objectives, and associated responses to climate change (Meridian Institute 2011: 16). Carbon-neutral agriculture, in the context of huge global food-security demands, is extremely challenging, and it may be ‘more appropriate to focus policy interventions on meeting food security equitably by enhancing climate resilience of production and distribution systems without commensurate increases in emissions’ (Meridian Institute 2011: 92). ‘Integrated approaches (eg, landscape, ecosystem and value-chain approaches) are likely to be useful in balancing multiple goals in land-use and food systems’ (Meridian Institute 2011: 92).

AAS organisations or individuals have an implicit vision of agriculture (see Table 4, p 19). It was beyond the scope of this study to explore this in any depth, but from the literature the dominant narrative posits agricultural innovation as a driver of productivity, economic growth and hence poverty reduction. In most, if not all, countries, public policy on agricultural innovation does not look beyond high input, high energy, high water use. Some organisations in the third sector and some individuals in all sectors appear to be embracing alternative lower-input, less resource-intensive visions of agriculture and innovation. UNEP (2011) attempts to decouple economic growth from high resource use through a ‘green economy’ approach. A review by Morey *et al.* (2011) indicates that innovation consistent with a green economy/low-carbon technologies are likely to come from the developing world and this may provide inspiration to African AAS and AIS individuals and organisations. AFAAS has a role to play in making these different visions and beliefs more explicit and creating space for alternative narratives.

In all three sectors – public, private and third – visions of success appear to have relatively short-term horizons. In the public sector, this is largely driven by political necessity; in the third sector, often by funding-agency timelines; and in the private sector by profit imperatives. There are exceptions, including the 2020 and 2025 vision processes led by the public sector; various climate change alliances in the third sector; and in the private sector motivated by, eg, CRS, certification. The majority of direct funding from all sectors appears to be striving for

short-term success with only lip service paid to longer-term sustainability and strengthening of adaptive capacity. At the local level, farmers and local communities also need incentives and support to plan and act with longer time horizons.

In terms of achieving equitable agricultural development, many current government policies typically seek to achieve this objective through poverty-reduction strategies, and in specific gender policies. However, how this is prioritised, interpreted and implemented by AAS varies between AAS sectors and countries. Many NGOs have an explicit pro-poor focus. There are many different motivations with respect to targeting the poor in private-sector organisations.

The need to strengthen farmers' organisational capacity tends to be viewed differently across the AAS sectors. Many organisations in the third sector, including farmer organisations, aim to strengthen farmers' organisational capacity as a means of strengthening their collective action to negotiate, advocate and secure rights. In the private sector, the motive for strengthening farmers' organisational capacity varies from the need to secure produce on a regular basis to ethical trade concerns. Public-sector organisations are in most cases now working with farmer groups as a cost-effective way of delivering AAS, but generally empowerment does not appear to be a major motive.

Government agricultural and environmental policy statements generally emphasise a need to embrace scientific or more formal knowledge and associated technology. In relation to seed, for example, although farmers in most countries in SSA are dependent on informal seed systems, most policies are geared towards development and promotion of modern varieties. In the case of seed, many or even most private-sector organisations tend to value scientific knowledge more strongly. The third sector has tended to place more value on local people's knowledge than the other two sectors.

National public environmental policies generally embrace UN agreements on, eg, biodiversity, desertification and climate change. However, with regard to agriculture, CAADP and national policies prioritise increasing productivity and this implicitly involves resource-intensive farming, in some cases highly subsidised by governments. The third sector probably has the most interest in adapting to change through alternative innovation, but probably has the least capacity.

4.2 AAS Management

It is increasingly recognised that AAS organisations require a flexible management approach, well-motivated staff, and incentives for learning and innovation. Adaptive management sets an even higher bar, including: basing decisions on policy learning and use of climate science and knowledge to develop new practices; matching to ecological processes at appropriate spatial scales (eg, decisions about agricultural water use need to take into account water catchments that cut across administrative and political boundaries); identifying alternative scenarios and types of responses; evaluating options for resilience; understanding and challenging assumptions; having frameworks for cooperation among administrative levels, sectors, departments; embracing the diverse motives, incentives and orientations of AAS providers; engaging with AIS stakeholders in developing solutions; and explicitly addressing uncertainty and incomplete knowledge.

4.2.1 Public sector

Public-sector AAS organisations in SSA have a reputation for a top-down, rule-based style of management. Christoplos (2010a) suggests that advisory services are ‘sticky institutions’ in that they tend to continue with the modalities and norms that have governed their work in the past. In many SSA countries, external interventions have attempted to change the role and management style of government extension services. This has often included taking on more of a coordination and M&E role for their working area, rather than directly providing advisory services. However, in most countries government extension services have held on to their traditional AAS role. This restricts the ability of the AAS to be adaptive, because this requires, among other things, cooperation between levels, engagement with diverse stakeholders in developing solutions, and changes in roles (eg, of extension workers) to explicitly address uncertainty.

The nature and extent of decentralisation or devolution can create both opportunities and challenges for adaptive management. For example, in Malawi, structural changes to the Ministry of Agriculture (MoA) have led to the creation of district offices; instead of being funded directly from MoA headquarters, MoA district offices are funded for their operational costs through the Ministry of Local Government and Rural Development. However, relatively insignificant amounts find their way to the district levels (Chinsinga 2008). Decentralisation reforms have led to a policy of pluralistic and demand-driven agricultural extension services, including wider involvement of stakeholders and promotion of participatory planning and implementation of agricultural programmes. While there is evidence of MoA district offices trying to be demand-driven, they have been constrained by decisions taken at the centre usually driven by grand-scale national development strategies and donor-funded vertical projects (Chinsinga 2008). Most challenges arise from a lack of clarity on operating principles, standards and procedures governing service delivery in a decentralised environment. This is largely due to the decentralisation process itself being incomplete. According to Chinsinga and Cabral (2010), *‘the decentralisation process has stalled. Malawi has been without elected councillors since May 2005 and there have been several signs of recentralisation tendencies. There have been some fundamental amendments to the Local Government Act which suggest a complete reversal of the decentralisation process. The implementation of stakeholder panels as a mechanism for rolling out the demand-driven provision of extension services has effectively stalled in the last two years. The fertiliser subsidy policy is by and large a centrally-driven initiative which is quite demanding of local staff and local resources – at the expense of routine activities, including the provision of extension services, water and soil conservation, as well as other locally defined priorities’*.

In apparent contrast, in Tanzania, discussions with district extension staff about District Agricultural Development Plans suggest that, although funds are limited, they do seem to be reaching the districts. In theory, at least, there is more pressure being applied on the district authorities to become learning organisations/agencies in response to decentralisation.

In Malawi, both the interface between agricultural-sector stakeholders and internal coordination within the MoA are problematic. This means that there is very little interaction among stakeholders within the agricultural sector regarding planning, implementation, resources mobilisation, monitoring and evaluation. The MoA interface with NGOs is stronger at field-staff level than at district level (Chinsinga 2008).

M&E appears to be mainly project based with a focus on measuring activities, outputs and more visible short-term impacts. From personal experience, although individuals may hold strong views, AAS management processes do not encourage systematic learning based on pilot policies.

Incentives, motivation and morale are key aspects of any well-functioning organisation – and this is also the case for adaptive organisations. Given the challenges ahead and the need to change behaviour and mindsets to respond to climate change, this will require strong incentives, morale and leadership. Under decentralisation in Tanzania there is quite a wide range of leadership styles (authors’ observations). In Nigeria, the motivation of extension agents is shaped by financial incentives, remuneration and salary, mobility of staff, in-service training, staff welfare, management relations, performance rewards, access to technical information, financial status of the service, communication systems, recognition of achievement, job prestige, opportunities for promotion and growth, and work challenges (Fabusoro *et al.* 2008). A comparison between public and university extension systems in Nigeria (Madukwe and Eze 2002) found that each has comparative advantages, which they should focus on and should be made to complement each other better. The university had greater autonomy in agro-technology generation compared to the public service, but the latter involved farmers more in their field research trials. The university grouped farmers and targeted them with programmes based more on need while the public service did so in terms of technology transfer, but the latter had better knowledge of broader rural dynamics. The public service had poorer staff training facilities and training compared to the university system.

In Ghana, MoA staff have reported challenges relating to poor timing of funds, lack of motivation, mindset, staff management and bureaucracy in the ministry (C:AVA 2008a). In Tanzania, an assessment of professional morale among key AIS stakeholders in the Southern Highlands in 2005–2006 found that in general there had been improvement compared to 5 years earlier (2000), due to funding, salary and incentives, recognition and self-development. However, access to training and, to a lesser extent, information and products, were of some relevance to a number of participants (Nsemwa 2006).

In Malawi, there is evidence that differences in the incentives offered are significant between those employed in the public-sector AAS and those in NGOs (*see* Table 9). In Mozambique, the ability to attract or retain staff is limited due to inadequate remuneration (World Bank 2006).

Table 9: Salary differentials between the NGO sector and Ministry of Agriculture (MoA) in Malawi

Position	Salary in MoA (Malawi kwacha)	Salary in NGO (MWK)
District Agricultural Development Officer (DADO)	39,000	250,000
Agriculture Extension Development Coordinator (AEDEC)	13,000	100,000
Driver	5,000	78,000

Source: Chinsinga (2008).

4.2.2 Third sector

Management systems vary tremendously among organisations in the third sector. This sector has often taken the lead in promoting participation and empowerment of vulnerable groups and, for many NGOs, this is reflected in a relatively participatory style of management.

Many development NGOs have invested significant resources in strengthening their internal learning processes. Edwards (1997) identifies four types of learning that international NGOs may engage in: (i) field-based participatory learning; (ii) project-based learning; (iii) policy and advocacy-based learning; (iv) vision exploration – envisioning the future.

The management and influence of farmer organisations (FOs) varies significantly among countries. Thompson *et al.* (2009) researched the roles, functions and performance of farmer organisations in Ethiopia, Kenya and Malawi, and found that FOs have ‘*a mixed record in all these areas and urged caution in relying on them for too much to drive any kind of major changes in the agricultural sector in Africa*’. However, in Niger, under a process assisted by the Food and Agriculture Organization of the United Nations (FAO), FO representatives participated from the very start in consultations under the rural development strategy (*Stratégie de Développement Rural*, SDR) for the review of the advisory system. As members of the National Steering Committee and through their own workshops, the FOs participated throughout the process, from contributing to the terms of reference to the last version of the proposal for a new advisory system. They thus exerted considerable pressure to establish a demand-driven system and participated in its development (Blum and Mbaye 2009).

Every year, the FOs in Niger have an audience with the President of the Republic. In 2008, one of the main federations of FOs used this opportunity to express to the Head of State their vision of an advisory system based on farmers’ demands. This request was made in the presence of the Executive Secretary of SDR. This has changed the attitude of government offices, which then participated in the process with a greater openness to a central role of FOs in the advisory system (Blum and Mbaye 2009). The 26 organisations of the Platform Paysanne du Niger (Farmer Forum Niger) are members of the Réseau des organisations paysannes et de producteurs de l’Afrique de l’Ouest (ROPPA, network of farmers’ and agricultural producers’ organisations of West Africa; ROPPA nd), whose struggle for the achievement of fair international trade and food sovereignty is recognised around the world (ROPPA 2008). Billital Maroobé (Réseau Billital Maroobé nd) is a Niger-based network organisation of farmers and pastoralists whose mission is advocacy of members’ interests within the institutions of the West African Monetary Union (WAMU) region, the Economic Community of West African States (ECOWAS) and the Liptako Gourmam Authority (a regional organisation whose vision is development of the contiguous areas of Mali, Burkina Faso and Niger).

Monitoring and evaluation systems in the third sector also tend to be project focused, with an emphasis on assessing activities, outputs and more visible short-term impacts. However, some NGOs have taken a leading role in developing and implementing participatory M&E methods as a means of empowering target groups. Some NGOs have a reputation for more sophisticated organisational M&E systems.

Staff in third-sector organisations typically appear relatively well motivated and with higher morale than those in the public sector. Reasons for this vary. In Tanzania, recognition, self-development and relationships with others were mentioned by some NGO staff as positive

factors (Nsemwa *et al.* 2006). In some countries (eg, Malawi) and for some organisations, NGO salaries are considerably higher than their public-sector counterparts (see Table 9).

4.2.3 Private sector

There is a diversity of private-sector organisations involved in AAS (as explained in section 4.1.3). Management styles, M&E systems and incentives vary between organisations. However, there is very little documented information available.

Deogratis and Mattee (2001), commenting on private agribusiness in Tanzania, noted that the main types of private agribusiness firms are those that distribute and market agricultural inputs such as seeds, agrochemicals and equipment; those that deal with processing; and those that procure agricultural products, especially cotton, coffee, tobacco, cashew nut and other cash crops. Nearly all private agribusinesses maintain a simple and less-bureaucratic organisational structure with a small cadre of staff. In general, the organisational structure, like that of NGOs, varies very much from one company to another depending on the purpose and size of operation of the enterprise.

4.2.4 Summary discussion: AAS management

It is mainly NGOs that have explicitly addressed the issue of strengthening farmers' adaptive capacity. Many funding agencies still emphasise shorter-term impact rather than longer-term capacity strengthening. In terms of equitable development, NGOs have tended to take the lead among AAS organisations in terms of targeting different groups, eg, the more vulnerable, although this is also becoming more common in public-sector AAS. Typically, public- and third-sector monitoring systems are project based and, depending on the priorities of their funding agencies, may measure performance in terms of improving access to and control of assets by different groups. Pressure to demonstrate short-term impact creates an incentive to work with groups with more assets and focus on shorter-term livelihood impacts. Evaluations rarely assess the actual longer-term impacts.

It would be expected that rewards for localised innovation should be greatest in the private sector. In the agribusiness sector, however, there appears little evidence of innovation. For example, a common approach among agri-input enterprises appears to be to take technology from elsewhere and try to sell it with little consideration of tailoring to the local context.

Few organisations in any of the AAS sectors appear to have management systems that reward changes for sustainability purposes. Exceptions include NGOs that have an environmental and agricultural aim (eg, WWF UK) and private companies involved in organic agriculture or other environmentally focused certification schemes.

4.3 AAS capacity

The capacity of service providers (public, private, NGO) to respond adequately to the significant challenges of climate change is a critical question. There is, however, very limited information available about actual practices and capacity on the ground in different countries. Key aspects of extension capacity are the level of staffing, qualifications and training of staff, geographical coverage, financial sustainability, equipment, training and skills in relation to climate change, infrastructure (eg, ICTs and climate change), and financial resources.

4.3.1 Public sector

Until recently, many public-sector AAS organisations suffered from major under-investment, but there is an increasing recognition of the need to strengthen their capacity (Davis 2009) in order to enable them to respond to the changing agricultural context, such as increased pressure on land and food security, technological innovations, and global economic integration (Larsen *et al.* 2009; World Bank 2007).

A major strength of many public-sector AAS organisations is their large number of staff. However, the ratio of extension workers (EWs) to farmers varies significantly among countries – for example, in Nigeria 1:3333 (Davis 2011); in Malawi 2167 staff (2009), with EW–farmer ratios estimated at 1:1000 in Dedza district and 1:3000 in Thyolo and Rumphi districts; and in Tanzania about 7800 state EWs and a ratio of 1:2075 (Tumbo *et al.* 2010).

However, staffing levels are often still reported as low. For example, in Malawi, Chinsinga (2008) reports that the MoA district offices have serious personnel shortages at all levels due to: the closure of the only nationally accredited training institution for nearly a decade; the devastating impact of the HIV/AIDS pandemic; and an increasing number of staff retiring without replacement. Low population densities limit coverage of rural populations by AAS in Mozambique. Only 13 percent of rural households are covered, having access to less than 700 extension workers (Loening and Perumalpillai-Essex 2005, based on IAF 2002/3, cited in World Bank 2006). Only one-third of districts are currently served and 50 percent of the population does not receive extension advice. Mozambican extension services are still weak, despite recent investment in equipment and training for staff. The ability to attract or retain staff is limited by inadequate remuneration.

Governance problems undermine cost-effectiveness and financial sustainability in Mozambique (World Bank 2006) and other countries. The sustainability of AAS has been undermined by the fluctuating interest of donors upon which it is reliant.

Targeting is also a key issue in considering extension capacity. The ECON (2005) study in Mozambique involved 500 farmers and indicated that extension is benefitting primarily the poorer-income quintiles (despite coverage being lower in poorer provinces). Government extension is present in 52 of the country's 128 districts, whereas NGOs provide extension in 42. More governmental resources should be allocated to the poorest provinces (World Bank 2006), because the poorest provinces receive less extension advice than other provinces and this is exacerbated when NGO and commercial services are included in the analysis. Despite double the number of NGO extension workers compared to public-sector ones, more villages report access to a government extension service than an NGO one (World Bank 2006). The conclusion drawn is that the NGO service is not contributing to an equitable profile of extension services.

Although coverage is wide, the capacity of staff to perform is variable for various reasons. In Benin, the capacity of Central Region for Agricultural Promotion (CeRPA) staff is regarded as relatively weak. Recent programmes, such as the Strategic Plan for Agricultural Revival (PSR-SA; Republic of Benin 2010), include a commitment to strengthen the public AAS. In Ghana, insufficient staff and resources and the need for capacity strengthening of female members of Ministry of Food and Agriculture (MOFA) to train processors in the community were some of the weaknesses mentioned by MOFA staff about their own capacity (C:AVA 2008a).

In many cases, the salaries of extension staff make up a high proportion of the total budget from the government and, unless projects provide funds, there is little or no funding for AAS activities. For example, in Nigeria the State government employs the staff and provides some operational funding, while other projects provide resources (eg, the Roots and Tubers Extension Programme [RTEP]). In Ghana, a high proportion of the government budget goes to staff costs, and operational costs appear to be largely dependent on donor-funded projects.¹⁴

In Tanzania, the total budget of all District Agricultural Development Plans (DADPs) was US\$ 63.8 million in 2008/09; \$45.5 million in 2009/10; and \$45.1 million in 2010/11. There was an average allocation of \$10.4 million per year (19.4 percent of total budget) to irrigation facilities, \$2.2 million to charcodams (4.2 percent), and \$0.2 million (0.3 percent) to soil and water conservation. Recurrent expenditure on extension staff in agriculture in 2008 was \$278 million (Tumbo *et al.* 2010).

In Malawi, the funding situation is hugely unpredictable coupled with *ad hoc* budgetary cuts and a lack of timely communication to MoA officials when cuts are to be made (Chinsinga 2008). There has been massive under-investment in state extension training skills until relatively recently. In Malawi, the majority of people holding key posts at the district level are under-qualified (Chinsinga 2008).

In Ghana, district MOFA staff identified that they had limited capacity to deliver business/entrepreneurship training, identify and work with vulnerable groups, and strengthen farmer organisation and empowerment (C:AVA 2008a).

In some countries (eg, Tanzania) the lack of investment in human capital is starting to be addressed through, for example, staff being sent for higher-degree training. However, Chakeredza *et al.* (2009) '*recognised that although tertiary agricultural educational institutions in SSA are expected to advise on solutions to the climate change challenges facing the continent, in their present state these institutions are ill-equipped to move with speed to address these issues. There is currently an urgent need to integrate climate change into the curricula whether as a full-fledged course or as a component within other courses*'.

ICTs have a crucial role to play in terms of enhancing capacity for accessing information, communication and localised innovation with respect to climate change. Although there has been dramatic change in the ICT environment in Africa, this does not yet seem to have been fully embraced by state extension services. In many instances, individual AAS staff are using their own initiative to pay for and access mobile phones, the internet and other ICTs. From our experience, many state extension individuals are taking the initiative and bearing the cost of accessing and using ICT services.

Leadership is important for successful organisational change processes, especially in 'sticky institutions' that are resistant to change. Climate change challenges will also require strong leadership to think through and implement the types of changes necessary. However, in some cases leadership is weak. For example in Ghana, '*Recent external and internal reviews have indicated that MoFA does not currently have the capacity to lead the development of the agricultural sector, a particularly critical role in the absence of a vibrant private sector*' (Feed the Future 2010).

In Tanzania, there is state agricultural extension representation at national, regional, district and ward levels and in some villages. There is a trend towards re-investment in human resources, transport equipment and roads, and ICT at district level. Tumbo *et al.* (2010) estimate the climate change adaptation cost of extension in Tanzania at \$18.7 million, rising to \$343.6 million in 2030 and about \$580.6 million in 2050.

In Malawi, Chinsinga (2008) notes that there are significant differences in the perceptions of stakeholders about what the MoA should be doing and what it actually does at the district level. While most MoA officials and smallholder farmers emphasise tasks bordering on service delivery, other stakeholders see coordination, policy governance and monitoring as the primary functions for MoA. The MoA district-level offices have very weak operative capacity both in terms of technical competence and financial capability to effectively deliver services to farmers.

In Mozambique, a whole range of things are identified by the World Bank (2006) as being necessary to improve extension services. For example, improving staff training and salaries, and focusing on smallholder groups (not those of interest mainly to private-sector companies). While some of these may be part of responding to climate change, they are not couched in climate change language. Linkages to the private sector for cash crops are recommended to increase impact in Mozambique (World Bank 2006). Public-sector staff should train private-sector workers, who will then provide extension advice while retailing their inputs (World Bank 2006). In Benin and Senegal, donors fund NGOs that work with public-sector AAS, involving their staff in NGO programmes and providing training, etc. While these partnerships may help to upgrade the capacity of public-sector services, they will not necessarily contribute to broader reform within the public AAS organisations, and there are likely to be targeting and equity issues when the private sector is involved, since they are less likely to reach the very poorest.

There is already a need for systemic capacity improvement and this is exacerbated by climate change demands. This may require some major rethinking. One commentator referring to Kenya and Malawi makes the point that:

Building state capacity is a long term agenda that involves the tackling of intractable systemic problems. For example, changing how the performance of civil servants (such as Ministry of Agriculture officials in district offices) is monitored and rewarded requires the forging of a policy consensus, the passage of any necessary legislation, then implementation of the new procedures, before any change in behaviour is observed. Such reforms can expect immediate opposition, even if only from bureaucratic vested interests, whilst politically, any dividends will only be reaped by a president's second term (at the earliest), which is really too late! Indeed, classic second term behaviour by a president who cannot himself stand for office again is to fill senior government positions with his own people (his legacy to them), and this may be made more difficult by comprehensive civil service reform. Thus, competitive electoral politics alone is unlikely to produce the incentives for the creation of 'developmental' states. Instead, in countries such as Kenya and Malawi, a national consensus on the importance of state building may be required, so that any president and party that comes to power continues the agreed work (Anon. 2009).

Such a consensus does not currently exist in either Kenya or Malawi, not least because there is little constructive dialogue on long-term policy issues among government, opposition and civil society.

4.3.2 Third sector

Organisations in the third sector often have limited capacity in terms of numbers of staff and geographic scope. However, some third-sector organisations have very extensive coverage and some countries have a large number of third-sector organisations. For example, in Malawi,¹⁵ Uganda and Tanzania,¹⁶ there are numerous NGOs. In some West African countries, such as Nigeria, NGOs appear to be less prevalent, while in Benin 23 NGOs were listed in the Worldwide Extension study (www.worldwide-extension.org) with known or assumed extension functions. World Vision in Malawi has 250 staff in southern Malawi alone and staff in every district with an office, under a Programme Manager. World Vision in Zomba, for instance, has a Food Security Coordinator who works at community level through Community Change Agents, who are drawn from the community, and who are not paid a salary but receive an honorarium.

Farmer organisations (FOs) are found throughout SSA, although their capacity appears to vary markedly. In some countries, there are FOs that operate across scales, although the extent to which these large-scale organisations represent local-level farmer views varies. In Benin, there are several major umbrella FOs, including Association Interprofessionnelle de Coton (AIC, interprofessional cotton growers association), Cotonou (www.aicbenin.org), and the National Federation of Producers' Unions (FUPRO) of which 80 percent of the country's cotton growers are members. FUPRO interfaces within the agricultural sector for policy formulation and implementation. FUPRO focuses on lobbying and advocacy, while the individual unions give management support to village-based farmer organisations (GVs) (www.fuproben.org). The unions are directed by elected bodies and have technical staff (managing director, accountant and agricultural trainers) (Kouton *et al.* 2006). In Niger, FOs contributed to the AAS-definition process through participation in a meeting at regional level and moderated by a farmer leader of ROPPA. During these workshops, the farmers defined the capacity-development needs of the FOs to elaborate the demand for research and extension services, and developed a mechanism for the expression of demand which builds upon farmers' consultations in each community, at departmental and regional levels. This was complemented by a component of technical advice for the formulation of the demand and by a fund for financial support called *Fonds d'appui aux services rural régis par la demande* (FASRRD) to help farmers to pay for advisory services provided by NGOs, the private sector or public agents (Blum and Mbaye 2009).

Other examples of FOs are the Centre de Gestion et d'Economie Rurale de vallée du fleuve Sénégal (CGER VALLEE, centre for management and rural economy of the Senegal River Valley: 23 extension staff in 2009) in Senegal. In Malawi, FOs include the Farmers Union of Malawi (8 staff in 2009), Mzuzu Coffee Planters (23 staff in 2009), and Organic Growers Association (15 staff in 2009). In Tanzania, Mtandao wa Vikundi vya Wakulima Tanzania (MVIWATA) is a national network of farmer organisations.

Training and skills vary considerably among organisations. It is still early days, but many NGOs are ahead of the curve in learning and developing staff skills. However, Biermann (nd) concludes that targeting climate change through a discourse that situates it independently from other stressors and as a distinctly local phenomenon may lead NGOs to unnecessarily limit the

adaptive capacity of their partner communities. There is an element, in the climate change arena, of climate being given priority over other issues and challenges – not least because of the donor funding that is available for research and projects.

Third-sector organisations, particularly international NGOs, often prioritise access to ICTs, particularly the internet. However, it was not possible to access detailed information on how NGOs are currently using their ICT facilities.

Effectiveness of advisory services and targeting are two critical indicators of a successful AAS and this will apply to adaptive AAS as well. Research by Loening and Perumalpillai-Essex (2005, cited by World Bank 2006) in Mozambique finds that extension services provided by NGOs are more effective than public ones, but the latter more effectively target poor people in rural areas (World Bank 2006).¹⁷ A concern is raised regarding sustainability, because of NGO reliance on donor funding (World Bank 2006), although the public extension service has also suffered from fluctuating interest from the donor community. Private-sector providers have much less coverage and do not prioritise the poorest farmers. Climate change vulnerability patterns will overlap with patterns of poverty, but are not completely synonymous. A great deal of work is underway to map patterns and hotspots of climate change vulnerability and these should be drawn upon by AAS in their planning.

In terms of adaptive decision making, some organisations in the third sector are likely to have a comparative advantage over the public sector.

4.3.3 Private sector

Private-sector capacity varies tremendously according to the nature of the organisation (see examples in Boxes 13 and 14). Companies dealing with input or output markets inevitably focus their resources in those areas where the market exists. Particularly in terms of inputs supplies, most of these firms tend to concentrate in high-potential areas where demand for their products is likely to be highest (Deogratias and Mattee 2001). Other than tobacco companies, which place a cadre of field staff actually in the village, the rest confine their activities to urban centres. With the exception of international firms, which procure crop produce, most (locally based) firms are small in terms of capital and size of operations. In Mozambique, just 11 percent of extension workers are commercial or private, and these are concentrated in a limited number of districts in three provinces, focusing on the minority cash-crop farmers.

The level of training and skills within private-sector enterprises is likely to vary tremendously. Deogratias and Mattee (2001) comment on a lack of qualified staff in the private sector, which reinforces dependence on government extension staff in Tanzania. But there is limited information available in the literature. A key issue appears to be whether the company or other parties are willing to invest in the ongoing training and skills of their staff. In enterprises that are linked to input or output markets, training is likely to be on very specific technical or business messages.

For enterprises dealing with certified products, capacity strengthening may be provided as support for complying with standards. For example, Wakulima Tea Company (WATCO) has contracted The Tea Research Institute of Tanzania to supply AAS to tea growers in Rungwe district of Tanzania. The main Fairtrade body, Fairtrade Labelling Organizations International (FLO) in Bonn, has a producer-support service and regionally based liaison officers that

Box 15: Examples of private-sector capacity

Katani, Ltd Tanzania employs extension staff (19 people in 2009) under a Sisal Smallholder and Out grower Scheme (SISO) started in 1999. The aim of the scheme is to change the current plantation-based mode of production to smaller commercial-sized units run by smallholder/out-grower farmers. Katani as a sisal-processing company is providing land, expertise and other services, such as seed and transportation. The company assists farmers in forming registered community-based organisations, accessing loans and grants to pay for services rendered, and facilitating repayment of loans to financiers. The target group has been villagers surrounding estates owned by the company, former/current workers in the sisal industry, and other Tanzanians interested in developing sisal as a cash crop. The minimum area for these smallholders is 6 ha and in between the rows of the young sisal, farmers can grow annual food crops or keep cattle. The smallholders have organised themselves into a cooperative society that enables them to collectively negotiate for services and prices for their produce, mobilise resources, and offer collective monitoring of the project. Katani has developed a manual on sisal growing in Swahili and an economic analysis for the recommended minimum holding of 15 acres (6 ha) per family. The company has extensive linkages to marketing systems and managerial expertise in sisal growing, processing, research and development (www.katanitz.com).

Malawi Alliance One International (51 staff in 2009 mainly diploma level; motorcycle transport) is an independent leaf tobacco merchant. Alliance One selects, purchases, processes, packs, stores and ships leaf tobacco. In certain developing markets, it also provides agronomy expertise and financing for the growing of leaf tobacco(www.aointl.com).

Bio Energy Resources Ltd (98 staff in 2009 mainly diploma and degree levels; bicycle transport) is a Malawian company that was established in 2006 with the sole purpose of developing bio-energy production on a commercial basis within a sustainable framework (www.berl.biz). BERL is promoting planting of *Jatropha curcas* as feedstock for the production of biofuel. Production of *Jatropha* is through contract growing with smallholder farmers and commercial growers.

Britania Company Uganda is processing a range of food and drinks, including fruit drinks. The company employs agronomists to advise farmers and encourage production of fruits such as mango.

Sources: Mainly as reported on company websites and the Worldwide Extension Study (<http://www.worldwide-extension.org/>)

provide certified Fairtrade producer groups with capacity strengthening to comply with their standards. FLO is increasingly seeking partnerships with other service-delivery organisations, in recognition of the limits of its own capacity to provide producer support, and is seeking partnerships for technical advice, investment, access to credit, etc.

Companies that are motivated by CSR or public relations may target geographical areas where there is a perceived need for action. In Nigeria, for example, the Agip Oil Company-sponsored Green River Project is being implemented in works in the oil-producing Delta region (mainly providing planting material of crops such as cassava, maize and yams to farmers).

Many multinational firms are not interested in directly financing extension services, as this appears not to be their primary activity, unless there is a security of supply issue as in cocoa in West Africa for example. Locally based firms, besides lacking competent or qualified staff, have limited working capital, which, in a way, hinders them from providing goods and services that fall in the domain of public goods. Thus, if private agribusiness companies are to be involved in extension services, various strategies should be used to encourage their participation. Deogratias and Mattee (2001) suggest that encouraging out-grower schemes is a potential strategy, as well as placing appropriate policies and incentives, particularly with regard to marketing and prices. However, while out-grower and contract schemes may have positive outcomes for farmers, this is not always the case, and more consideration is needed

Box 16: Kilimo Kwanza Growth Corridors Initiative, Tanzania

In Tanzania, the Initiative launched a public–private partnership to mobilise private-sector support in order to action Tanzania’s national agriculture strategy, ‘Kilimo Kwanza’ (‘Agriculture First’). Based on the direct mandate and support of President Jakaya Kikwete, an Executive Committee is focusing initial efforts on preparing a ‘blueprint for public–private investment’ aimed at developing commercial agricultural growth in the Southern Agricultural Growth Corridor region (SAGCOT). Southern Tanzania has significant ‘natural’ potential for building a profitable agriculture sector. It has good soils, climate and water resources, and a reasonable and improving ‘backbone’ infrastructure providing access to local, regional and international markets. The Executive Committee will identify clusters of profitable, scalable agricultural and service businesses, with major benefits for smallholder farmers and local communities. The aim is to establish a critical mass of profitable, modern commercial farming and agribusiness, focusing on carefully selected areas and crops with high market potential. Building on existing operations and planned investments, the clusters will be centred on areas of particularly high agricultural potential and might include nucleus large-scale commercial farms and smallholder out-grower schemes; serviced farm blocks; processing and storage facilities available to commercial and smallholder farmers; and improved infrastructure to farms and local communities.

This blueprint will act as a strategic plan to mobilise, align and leverage both public- and private-sector investments into these viable opportunities.

The Executive Committee of the Kilimo Kwanza Growth Corridors is a multi-stakeholder effort, consisting of representatives of the international and Tanzanian private sector, farmer leaders, the Tanzanian government, donor institutions, civil society and foundations. The Executive Committee is co-chaired by the Minister of Agriculture, Food Security and Cooperatives of Tanzania and Unilever (representing a consortium of seven global companies). The consortium of World Economic Forum Partners supporting this initiative comprises DuPont, General Mills, Monsanto Company, Syngenta, SABMiller, Yara International and Unilever. The Forum Partners are represented in the Executive Committee by Unilever and Yara.

Source: www.weforum.org/issues/agriculture-and-food-security.

of the potential exposure to risk for smallholders, barriers to participation and the content of contracts.

In terms of linkages between the private sector and other AAS providers, Deogratias and Mattee (2001) argue that the literature and experience show that only a few companies, and particularly those selling agro-chemicals and other inputs, are interested in collaborating with the government extension services as they use government staff to promote their products through field days, demonstrations and seminars – which are sponsored by the companies themselves. However, companies involved in crop procurement are less enthusiastic about collaboration or establishing linkages with other providers. There are proposals in the literature that public AAS should seek to collaborate more with private-sector AAS. With a good capital base and management (especially the locally based companies), private agribusinesses may be well placed to provide private goods and fill the vacuum left by public institutions. They also stand a better chance of complementing government efforts for commercially oriented farmers. While withdrawing from provision of public services, the government may tap this potential by encouraging private agribusinesses to become involved in the provision of support of extension services. However, as shown by experience in the UK, such services tend to be closely linked to the sale of inputs.

In terms of financial and organisational sustainability, the AAS provided by private companies depend upon changes in their operating environment. Profit maximisation is the primary objective of most companies and, so long as it is profitable to conduct business and be involved

in extension activities, resources will continue to be devoted to these activities. Overall, services provided by most of these companies are dependent on the prevailing economic environment in the country, ie, some may decide to close down their operations if they happen to make losses or very small profit margins. What impact might climate change have on provision of AAS? To secure supply chains there is quite a lot of discussion and concern among those buying in developing countries (eg, cocoa, coffee, tea) about what the impacts will be and how to secure their supply chains. In Ghana and Côte d'Ivoire, several companies have been investing in social and economic development for cocoa farmers (eg, Mars, Cadbury, Nestlé) and this may include agricultural advice to increase productivity.

Although these firms appear to have some potential, there are serious weaknesses, which may impair efficient delivery of extension services, such as:

- Limited financial resources (especially for locally based enterprises)
- Providing goods and services generally unaffordable to poor farmers
- Lack of qualified staff, which reinforces dependence on government extension staff
- Concern more with enterprise than the personal development of the farmer
- Selective dealings with specific enterprises
- Focus on wealthier clients who can afford their services
- Very strong linkages required in the services, eg, inputs, advice, marketing and processing to recover costs.

4.3.4 Access to and use of ICTs

Over many decades in SSA, during the development of 'modern' post-1945 AAS, regular use of old ICTs (such as telephone or television) was rare for large sections of the rural populations, as well as for most AAS frontline staff. The most striking exception was radio, which quickly became widespread due to the availability of cheap battery-powered transistorised receivers from the 1960s. Many public AAS have maintained communication departments and produced regular radio programmes on agricultural topics for broadcast to rural populations, often through state-owned radio stations. In some cases, educational videos or TV programmes were also produced for screening either via mobile audio-visual vans or on the often state-run TV stations. Content was largely created and controlled by the AAS organisations and targeted at the farmer recipient.

Since the turn of the millennium, meteoric growth of private mobile-phone ownership and use in both rural and urban settings, increasing access to TV and video-screening facilities, and digital filming apparatus (cameras, mobile phones), and the more recent spread of internet access in towns and even into smaller towns and centres via mobile net services, have offered a whole new world of opportunity for multi-directional communication.

Interestingly, in our experience, even while AAS has embraced newer participatory approaches such as farmer field schools and farmer participatory research to mobilise communities and harness complementary contributions from researchers, farmers and AAS staff for innovation, AAS in general seems to have been relatively slow to explore opportunities for a comparable revolution in multi-stakeholder information sharing, knowledge creation and advocacy activities offered by combinations of new and old ICTs. Often, the default use of ICTs has tended to be the old one-way communication mode: from expert to farmer.

ICTs and climate change. A major challenge for ICTs in AAS vis-à-vis climate change issues will be to creatively develop ICTs as multi-way platforms and break with the unidirectional communication traditions of the past. It is not only AAS staff who are in need of information and perspectives about climate change science and their expression in their local environment. Researchers and official meteorological stations are one source of these, but both AAS leaders and researchers also need to access and learn from the experience of farmers, frontline AAS staff and other sector staff living and working in the focus areas. When used innovatively, ICTs can do much to demystify both the world of the rural dweller at one extreme and climate science and its vision and limitations at the other.

There are increasing numbers of examples of innovative arrangements and use of ICTs, including the hugely popular M-Pesa e-banking system in East Africa, evolving tele-centre services in East and West Africa, mobile phone use for registration and exchange of production, market and health information, GIS to facilitate land titles and rights. An increasing mix of public-, private- and third-sector organisations are participating in these developments (Nyirenda-Jere 2010; IICD 2010; USAID 2010; Gakuru *et al.* 2009). Among promising new ways to use ICTs is the conveying of climate and environmental information and use in disaster warning and response. For example, in Zambia the Meteorological Department has recently launched RANET, a linked radio and internet project to provide local communities with weather, climate, early warning and related information through computers and digital radios (UNCTAD 2010). In Ghana, Vodafone Ghana, in collaboration with the Environmental Protection Agency (EPA), has launched a project dubbed 'Integrating Climate Change into Telecommunication Industry', aimed at supporting and contributing to environmental issues, especially in combating climate change. The project will see the integration of climate change into telecommunications in Ghana as part of a wider strategy to establish an early warning system for disaster prevention and recovery in Ghana (Aryee and Aidoo 2010).

These examples are starting to show that combinations of new and old ICTs would seem to lie at the core of the work to be done to harness ICTs more fully in climate change mitigation and adaptation. Work to exploit ICTs for AAS should at least seek to understand how communities and organisations already share information and are organised, to establish how ICTs can enhance the learning and information exchanges that take place within them (Hogan *et al.* 2011). However, no technology is gender neutral – but is introduced into an existing landscape of power relations. Without attention to existing social and gender relations, there is a risk that the technology could exacerbate inequalities or fail to capitalise on new opportunities for tackling social inequality.

4.3.5 Summary discussion: AAS capacity

There are capacity deficits in some public AAS, including overall provision and coordination, and there is increasing recognition of the need for urgent investment (eg, among donor agencies and foundations). However, beyond the existing need for increasing investment, climate change only increases the need and also changes capacity requirements.

The diverse environmental and social context in Africa has for some time suggested a need for localised agricultural innovation, and climate change has reinforced this point. This requires the ability to: (a) identify and analyse challenges and opportunities; (b) access information and know-how; and (c) put the newly acquired knowledge to use. The ability of AAS individuals

and organisations to contribute towards innovation is determined by their internal capacity and the wider AIS in which they operate. After years of underinvestment in African AAS, it should be no surprise that internal capacity is limited, but there are some signs that this is improving. However, further major investment is needed to strengthen AAS capacity in relation to agricultural innovation and for adaptation to climate change.

In order to strengthen farmers' adaptive capacity, AAS organisations need to be able to explore different scenarios and solutions with farmers and other AIS actors – and should include building farmer agency and voice in decision making. The facilitation skills and some of the concepts to do this are currently more likely to be found in the third sector, but overall knowledge and skills in this area are almost certainly very limited.

Adaptive capacity varies widely between individuals and communities, due to differing access to and control of assets and the institutional environment in which people are living. In order to strengthen adaptive capacity, AAS organisations need to be able to recognise these differences and develop strategies to address them. This has tended to be an area in which some NGOs in the third sector have capacity, although there is increasing recognition and capacity in some public-sector organisations. Private-sector capacity and motivation depends on the type of organisation.

Self-organisation is a key element of adaptive capacity. This again has tended to be a particular strength of the third sector, including farmer organisations themselves. There is increasing capacity in some public-sector organisations, although it remains an open question to what extent public AAS can play this role. Again, private-sector capacity and motivation again depends on the type of organisation.

Climate change has emerged only recently as a critical issue and so most AAS individuals would have received little specific training in relation to climate change in their formal training. In addition to this, as noted in a review by Chakeredza *et al.* (2009), most Africa training organisations have little current capacity in this area. Accessing and using knowledge and information in general has certainly been an issue for most public AAS organisations, which have often tended to be passive recipients of information (usually from public-sector research). This is starting to change, but many AAS actors have limited capacity to actively seek and use new knowledge and information. This is a critical factor that will have a major influence on the extent to which AAS will access information and networking initiatives such as AfricaAdapt (see Appendix 7 and www.africa-adapt.net/AA/).

AAS organisations operating in Africa have experienced major change over the years, often driven by government or funding-agency decisions. Third-sector and private-sector organisations have often shown a greater ability to adapt to change than public-sector ones. However, relatively few AAS organisations show capacity to shape change in the environment in which they are working.

4.4 AAS advisory methods

In moving towards adaptive AAS, the advisory methods used are critical. In dealing more explicitly with climate change and other uncertainty, methods need to emphasise such aspects as: strengthening the capacity of clients (rather than delivering messages), and enabling

clients to experiment and use climate information, strengthening the self-organisation of farmers, enhancing local-level innovation, improving links between research and extension, and considering the content of advice in relation to what is appropriate to the context (eg, balancing production-innovation, growth, and climate resilience).

4.4.1 Public sector

Interventions have promoted more demand-led, learning-based methods, as a balance to the dominance of message-based approaches. Although there is relatively little recent documentation, there appears to be a variety of approaches being used in the public sector – some examples are provided below.

In Benin there is trend towards more participatory and multi-disciplinary teams, working with community organisations and NGOs (GRAPAD 2006). In mid-2007, the Government of Niger requested FAO's technical assistance and set up a National Steering Committee to develop its AAS approach under a strategy for rural development (SDR). There was no emphasis on a particular advisory model, which gave room for developing a country-specific system based on existing institutional and organisational capacities and targeted to poor and vulnerable producers. The core process consisted of two main parts: (a) analysing and assessing the present extension system, and (b) designing a new advisory system – both parts were undertaken with the various stakeholders concerned (Blum and Mbaye 2009).

In Senegal, the role of the Agence Nationale de Conseil Agricole et Rural (ANCAR) 'is to establish a rural and agricultural advisory and counselling service for farmers that is able to satisfy to their needs' (ANCAR 2011). The aim is that the service should be a public good, not commodity specific and not connected with the provision of inputs.

In Ghana, the current approach to extension in Ho and Hohoe districts is essentially still T&V within a unified extension system (one extension agent interfacing with farmers for all subject areas). Agricultural Extension Agents (AEAs) are trained by development officers on a monthly basis (C:AVA 2008a). The Research Extension Linkage Committee (RELC) meets annually to plan extension activities for the year.

In Nigeria, many of the State Agricultural Development Programmes (ADPs) also appear still to be using a modified version of T&V. For example, Ogun State ADP Unified extension system has a single line of command to the farmer. Extension Agents (EAs) are trained every fortnight on recent innovations. Training is done by Subject Matter Specialists (SMSs) (examples of subjects are crop production, crop protection, women in agriculture). SMSs receive monthly training through Monthly Technology Review Meetings, which involve experts from research institutions, universities and NGOs. In Ogun, ADP activities include a shift away from working with individual farmers to farmer groups. There is also an emphasis on schools and young-farmers clubs¹⁸.

The World Bank-funded Fadama project in Nigeria is reportedly using a community-driven development approach. Fadama II sought to empower local communities and improve the government's capacity to reach out specifically to poor and vulnerable groups, such as women, unemployed youth, widows, and people living with HIV/AIDS. The strategy represented a shift from public-sector domination to a community-driven development approach, which is built around community-defined priorities. The participatory component was based on user groups

with common economic interests, such as farmers, fishers, pastoralists, women, the disabled, and students. These groups developed plans, and then each group requested money to pay for income-generating 'community-level assets', such as fishing nets, fertiliser, water-pumps and generators. When the local Fadama Development Committee approved a plan, the community put the contract out to bid and the winning bidder was paid directly from project funds. The project has boosted incomes for 2.3 million farm families in 12 Nigerian states. Household incomes increased by an average of 60 percent between 2005 and 2007. AAS led to improved livestock management, improved financial management, and better agricultural marketing techniques. Furthermore, demand for fee-based postharvest advisory services increased (World Bank 2011).

In Tanzania, the official policy of the Ministry of Agriculture is a farmer field school approach – although in practice the approaches used vary. Extension agents mainly target farmers in groups, sometimes targeting particular vulnerable groups (eg, through the Tanzania Social Action Fund [TASAF]). Some DALDO offices, for example in the higher-potential Southern Highlands, are training other stakeholders (eg, stockists on the safe management of chemicals).

In Malawi, both public- and private-sector service providers are primarily working with farmers through targeting of existing groups or by creating new ones. District Agricultural Development Offices (DADOs) are targeting groups, including faith groups, but there does not appear to be much emphasis on helping to organise these groups and clubs into larger entities such as associations. These organisations reported that they are facilitating farmers and their organisations to become more business-like, but are generally not explicitly supporting existing small businesses. DADOs are working with agro-input suppliers to monitor and assess distribution and sale of inputs. That way they track how much seed or fertiliser has been sold in each district, which is closely linked to the input subsidy voucher system. They are not supporting the estate sector.

In Kenya and Malawi, there have been moves towards a more 'demand-driven' approach to extension in recent years. This is seen by proponents (including sympathetic local technocrats) as a halfway house to either privatisation (fully private for those who can afford it; NGO provision for those who cannot) and/or decentralisation of service provision. It has proceeded furthest in veterinary services, due both to the nature of curative services and the fact that livestock farmers are considered better off than average. District case studies suggest that the 'demand-driven' approach is unpopular with farmers in both countries. In Kenya, extension staff do seem to make themselves available (at specific points within a given location at given time each week) for farmers to seek their advice. They like the fact that they are now dealing primarily with motivated clients, but recognise that more needs to be done to sensitise other farmers on the principles of the new approach. In Malawi, the roll-out of the new approach was supposed to be preceded by the establishment of stakeholder panels (at district, area and village levels) for both sensitisation and expression of demand. However, none is in place in any of the three districts studied. The technocratic vision of stakeholder panels was completely overshadowed by the success of the fertiliser programme, which enjoys strong backing at the highest political and policy levels. The narrative of the programme's success, which has seen the state act largely alone, effectively crowded out any space for alternative visions for improving performance of the Ministry of Agriculture (Anon. 2009).

4.4.2 Third sector

In the third sector, there are examples of projects and programmes whose aims could represent adaptive AAS.

In Benin, IDID (an NGO) is working in 35 of the 77 Rural Municipalities/Communes in the country. A programme of action-research has been established to bring together stakeholders at district, municipal and community levels and foster diagnosis, planning, implementation and reflection on results, formation of local committees, and development of means of sharing climate change related information (IDID-ONG 2009; Hounkponou *et al.* 2009).

In Ogun State, Nigeria, the NGO JPDM appears to have invested in capacity strengthening of farmers through the formation of cooperatives and groups. There are 60 cooperative societies (each with 10 members, and an overall ratio of 6 women to 4 men) with a total of 600 members. JPDM aims to expand the network and eventually for the network to become an Ogun State Agricultural Cooperative Network (C:AVA 2008b).

Also in Nigeria, Oxfam is seeking to strengthen the livelihoods of small-scale farmers through a 3-year project co-funded with the European Commission (EC) working with 6000 male and female small-scale farmers in Benue, Nasarawa, Plateau, Kano and Katsina in the middle belt and northern parts of Nigeria. The programme aims to work in partnership with the private sector to make 'markets work for the poor'. Key objectives include increasing agricultural productivity, value addition, competitiveness and marketing of key agricultural products. There is also collaboration with farmers, government, private sector and parliaments on policy reforms, increased investment and budget performance for better support services and increased agricultural productivity and competitiveness. A global Oxfam campaign on the rights of smallholders and promoting sustainable agriculture for food security and economic justice is focused on 10 countries, including Nigeria. In Nigeria, the national campaign is being implemented as 'Voices For Food Security' (VFS). This campaign involves smallholder farmer organisations, civil society partners in the EC co-financed livelihoods project, some Oxfam Novib partners, and strategic national and international NGOs with a mandate and/or programme on agriculture and food security. A campaigning consortium of these partners, allies and supporters has been established (the VFS Consortium). Through the strategic relationships established in the campaign, the work around support to small-scale agriculture/ farmers is being amplified across the country. One of the major goals of the programme is to increase investment in agriculture.¹⁹

In Senegal, the NGO ENDA-GRAF is working to enhance the visibility and value of the knowledge and tools that exist in local development efforts in theory and in practice. CNCR is the national council of producer organisations and there are many other NGOs involved in AAS (eg, Union 3 P, Confédération Paysanne du Sénégal, Mouvement Sénégalais pour le Développement).

4.4.3 Private sector

In some cases, farmer organisations buy in AAS from private providers as well as public-sector AAS. For example, in Benin, the AIC contracts in AAS from the Ministry of Agriculture and Fisheries, from the public AAS (CECPA – the Centres for Agricultural Promotion), and from NGOs and other service providers.

In Niger, the role of the private sector is weak as they rarely provide advisory services. They see their main role as the commercialisation of inputs and agricultural equipment. Most of them are individual service providers, only in the water sector do private consultancy firms exist. Their role in the future advisory system of Niger is based on experience from major development projects, and concerns water-related services (irrigation) and farm management, as well as the commercialisation of agricultural products and processing (Blum and Mbaye 2009).

In Tanzania, most agribusiness firms do not have their own extension methodology as they are dependent on government extension staff. Government staff are given token allowances, transport assistance and in-house training on very specific technical or business messages (Deogratias and Mattee 2001).

4.4.4 Summary discussion: AAS advisory methods

There has been a major move, particularly in the public and third sectors, towards more learning-based approaches to working with farmers (eg, farmer field schools). If implemented with commitment, these approaches can make an important contribution to strengthening adaptive capacity and will help achieve more adaptive AAS. There is limited evidence about the advisory methods used by different sections of the private sector.

In terms of the use of appropriate methods for targeting AAS to ensure that vulnerable groups are covered, the third sector is traditionally strong, whereas the private sector is generally not concerned with issues of equality. However, one study in Mozambique indicates that although third-sector extension services can be more effective, they are delivering less in equity terms. What is clear is that climate change vulnerability will overlay existing patterns of social exclusion, poverty and marginality – but there are also new challenges and areas that will also suffer from negative climate change impacts. Thus, more attention needs to be paid to the types of advisory methods that AAS use and to the content, eg, advising on probabilities, supporting farmer capacity to experiment.

Methods such as farmer field schools explicitly encourage experiential and shared learning. Climate change and variability are starting to be addressed by the third and public sectors through various projects (see section 4.5). It is much harder to assess private-sector methods where information is much less readily available. Methods such as farmer field schools do enhance adaptive capacity and there are examples where this is being applied to climate change (eg, biodiversity FFS in West Africa [Braun and Duveskog 2008], and climate change FFS in Indonesia). Another example is the FAO FFS initiative in Ghana (AGCommons 2009).

Improving the self-organisation of farmers is a critical aspect of adaptive capacity. Methods currently tend towards working with farmers in various forms of collectives. However, how these methods are implemented makes a huge difference in terms of longer-term change and real capacity for self-organisation. Programmes that systematically seek to build smallholder-farmer agency and that campaign for investment in agriculture support adaptive capacity.

4.5 Climate change and AAS initiatives: some examples

Having reviewed AAS governance and visions, management, capacity and advisory methods in the previous section, and the extent to which public-, private- and third-sector AAS might

be ‘adaptive’, we now review AAS climate change specific activities. A number of examples are provided of improving access to climate information and knowledge, of adaptation initiatives and of mitigation efforts.

4.5.1 Availability, access and use of climate and weather information

In this section, we review issues surrounding the availability of, access to and use of climate knowledge of different stakeholders.

Climate knowledge includes climate science, but also local knowledge and interpretations of climate and of adaptation practices. Climate knowledge is not uniform, but depends on the clarity of knowledge and the levels of vulnerability to the risks involved in climate change trends or a specific hazard (Ensor and Berger 2009).

- **Low clarity of climate knowledge:** in such situations emphasis might be placed on improving understanding and increasing investment in climate modelling or on strengthening the capacity of networks to demand access to more relevant climate knowledge from knowledge holders. Strengthening adaptive capacity and resilience can help act as a buffer to low clarity of climate knowledge.
- **Low vulnerability to a hazard:** this is assessed via a ‘starting point’ vulnerability analysis. Low vulnerability does not demand urgent action.
- **High vulnerability** does require urgent action.
- **Higher levels of clarity of climate knowledge, combined with high vulnerability to a particular hazard:** implementation of specific adaptation responses may be the priority (eg, sea-wall construction, developing drought-tolerant crops).

Climate change projections at a country level vary in quality and coverage. A major reason for this is the lack of long-term detailed local data sets. For example, the station network in Mozambique only has one station per 29,000 km² and has major geographical gaps in Gaza and Tete Provinces. There are also significant gaps in the data – which make it difficult to draw out trends and to downscale models to different regions (INGC report, cited by Macaringue 2010; McSweeney *et al.* nd). In Nigeria, there also capacity gaps: ‘*scanty and ill-equipped weather stations, and agricultural infrastructure*’ (Odjudo 2010, cited in Enete and Amusa 2010).

In many countries, there is investment in meteorological services and in modelling capacity, but there has been less substantial experience in the sharing and use of this information with farmers. An early exception was the Mali meteorological service which launched a pilot project in 1982 to provide climate information to rural people, especially farmers (Hellmuth *et al.* 2010). Farmers report that they feel they are exposed to lower levels of risk and are therefore more confident about purchasing and using inputs such as improved seeds, fertilisers and pesticides.

Some early research in this field indicates that there are issues to consider in terms of how local communities interpret and understand the climate (Strauss and Orlove 2003), how they understand information given to them, whether they do or can act on the information, the barriers to using the information, and impacts on the local community of scientific forecast data (Roncoli *et al.* 2003; Patt 2009). Early experiments in sharing of seasonal forecast probabilities with farmers found many challenges, particularly in explaining probabilities and in gaining and retaining the trust of farmers where on occasions forecasts did not fit with actual weather events.

Beyond climate science there are other important sources of climate knowledge, including local farmers' observations and indigenous and local adaptive practices. Access to this knowledge varies with power, influence and education. A number of initiatives have brought together the knowledge and skills of traditional forecasters and scientists in order to combine their abilities, improve the quality of local-level forecasting and share this with local communities – eg, western Kenya (Kituyi personal communication 2010) and Same district, Tanzania (Tumbo *et al.* 2010).

Further, there is often a lack of capacity in combining the use of different types of climate knowledge in adaptation planning.

Key questions, therefore, that AAS could apply to their own organisations in an evaluative sense, are the following:

1. What access to climate change science and climate-related information do AAS themselves have across SSA?
2. Who are they are sharing this information with and is it made available in a useable form?
3. Are research programmes generating climate change knowledge and information with the participation of farmers? How are they channelling this information and is it being shared in an effective manner?
4. Do AAS have a feedback loop to the climate change community on the impacts of climate change on local micro-climates, diverse production systems, markets and livelihoods?

How then will AAS need to change in relation to climate change information? Broadly speaking, Christoplos (2010b) suggests that extension services will need to '*engage with different actors, promote new forms of institutional development and provide a different array of services than in the past*'. It may often be different providers that provide extension services for climate initiatives. Extension approaches such as farmer field schools and study circles bring farmers and rural stakeholders together to discuss weather, farming and livelihoods, but these have to be scaled up and more informed – eg, information on uncertainty and vulnerability, and more effective ways of downscaling climate forecasts so that they are useful to specific agro-meteorological zones (Christoplos 2010b).

The greatest challenge is supporting smallholders on a sustainable basis²⁰ in using and adapting to this new type of information on a large scale and in a coordinated fashion. A key factor is the importance of building trust with users through repeat provision of information. Some farmers in the USA, Australia and New Zealand are already gathering and using information such as seasonal weather forecasts and advice on combining this with adaptations to probable market opportunities and risks. Within Africa, large-scale farmers and companies in some areas are making use of seasonal forecasts to inform management decisions (eg, aerial spraying of fertiliser on tea estates in Malawi). However, there are few examples of support for smallholders focused on choosing between production strategies based on information from seasonal weather forecasts and advice on appropriate crops and varieties, farming methods and market probabilities, etc., particularly when looking beyond the researcher-led pilots and within broader community-based adaptation projects to *sustainable* provision of services (Christoplos 2010b). In reference to these climate change related challenges, Christoplos (2010b: 44) states: '*the role of extension and communication (as well as applied research) in climate change adaptation and the question of capacity development of extension organisations and agents to manage these new tasks is largely uncharted territory*'.

4.5.2 AAS and climate change adaptation

There is an ever-widening range of potential adaptation options for incremental changes in existing systems at the farm level. Ifejika Speranza (2010) suggests:

- Adaptations of whole farming systems (eg, conventional, conservation and organic agriculture)
- Adaptation of agricultural practices (eg, soil and water management, seed management, crop management, agroforestry, reforestation and avoided deforestation, pest and disease management)
- Adapting livestock, pasture and rangeland management practices
- Farm-level climate change mitigation practices
- On- and off-farm diversification in livelihood practices
- Diversification of species and varieties grown
- Farmer organisation and social networking
- Taking up new climate finance, value-chain and learning opportunities.

There is some evidence that agricultural or agronomic adaptations will have some effect in the face of climate change. Howden *et al.* (2007), for example, working with a large sample of simulation studies for wheat yields under climate change, summarise the benefits of adaptation in terms of the difference between percentage yield decreases with or without agronomic adaptation. The technical possibilities of adaptation are important (Easterling *et al.* 2007). However, more severe climate change will require more major responses such as a complete change in farming systems or livelihood diversification and increasing seasonal mobility and migration, resettlement and industry relocation.

The diversity of farming environments, the complexity of livelihood strategies of marginal communities (Morton 2007) and the uncertainties of climate change combined with other trends and pressures, suggest a need for support for *localised innovation to enhance and sustain agricultural performance and resilience*. Localised innovation processes involve not only the generation of new technologies and farm-level modifications, but also the articulation of demand for and the testing of existing technologies that may be appropriate to new conditions. A critical aspect is the ability of AAS to support farmer experimentation and learning. Thus, there are many different potential farm-level innovations – but what is appropriate in any particular location may be difficult to predict given the uncertainties of climate change and lack of downscaled data. What is therefore of greater priority is the ability of organisations to be *flexible*, to be able to *learn* from their own and others' experience across scales and to identify new opportunities for farmers and other value-chain players, to *promote self-organisation and learning among farmers*, and to recognise the need for the development of diverse *approaches and solutions*.

At the policy and institutional levels, innovations and learning will be required, such as: responses to climate change in national policy and planning (eg, climate policies, but also PRSPs, disaster risk reduction, social protection, and sectoral policies); support for climate monitoring and early warning systems; crop research and improvement; agricultural extension services and outreach; rural radio services; rural finance, agricultural finance and microfinance; weather-indexed crop insurance; paying farmers for ecosystem services; strategic grain reserves (Ifejika

Speranza 2010). Developing value chains that promote adaptive capacity and resilience of farmers is necessary, but this means careful consideration of the balance between increasing income security and specialisation and exposure to market fluctuations and risks.

Although policy options have been identified for agricultural adaptation (eg, investments in infrastructure such as sea walls or drip-feed irrigation, capacity strengthening at community and other levels), there are environmental, economic, informational, social, attitudinal and behavioural reasons why these may not be implemented (Howden *et al.* 2007). There are also different kinds of adaptation decisions. **Tactical** decisions about practices in the next season or year may involve farmers, insurance agencies, markets and regional agricultural agencies. **Strategic** decisions cover multiple (1–5) years and may involve farmers and regional agricultural agencies. **Structural** decisions (concerning multiple decades) are more likely to be in the domain of national governments and regional agricultural agencies (Risbey *et al.* 1999), although they are often limited in their ability to act over longer timeframes. Farm-level changes are made at the management-unit level, but broader-scale changes involving resource redistribution, changes in land use, support for new livelihood options, regulation of markets, etc., *require changes in the decision environment* (eg, policy changes to encourage behavioural and institutional changes among enterprises and farmers).

Table 10 shows the avenues for changing management behaviour in the light of climate change as identified by Howden *et al.* (2007). It is not only managers, however, that will need to change their behaviour and decisions, but other AIS actors need to do so as well – with a full awareness of the implications of different future pathways that different approaches and narratives imply.

Responding to climate change raises some fairly fundamental challenges for international development, bringing into view longer time horizons in planning, for example, and the need to be able to respond to uncertainty and surprises (Boyd *et al.* 2010). *‘Climate change and responses to it are changing patterns of innovation, trade, production, population distribution and risk in complex ways. This is creating a new development landscape for policy makers, who need to nurture and sustain economic growth and social development in the face of multiple threats and uncertainties while also cutting emissions or keeping them low’* (Mitchell and Maxwell 2010). So, beyond thinking about adaptation, mitigation and development as separate spheres of activity, what is required is the creation of *‘climate strategies that embrace development goals and development strategies that integrate the threats and opportunities of a changing climate’* (Mitchell and Maxwell 2010). The notion of *climate-compatible development* is therefore proposed by the Climate and Development Knowledge Network (CDKN): *“Climate compatible development” is development that minimises the harm caused by climate impacts, while maximising the many human development opportunities presented by a low emissions, more resilient, future’* (CDKN nd). Policy makers are asked to identify ‘triple win’ strategies that simultaneously result in low emissions, build resilience and promote development (Mitchell and Maxwell 2010). This applies across all sectors, including agriculture.

Given such a wide continuum of activities that fall along the development–adaptation continuum (see McGray *et al.* 2007 and section 2 of this report), it is difficult to identify or label many activities as being specifically to do with ‘adaptation’. However, in this section we provide a number of examples (Box 18) and areas of activity (more details are given in Appendix 7). We have borrowed and modified some of the themes and examples used in a conference on community-based NGO-led adaptation in Dar es Salaam in 2010, and added

Box 17: Avenues for changing management behaviour in the light of climate change	
Convince managers of the reality of climate change	Policies which maintain climate monitoring and effective communication of this information (including targeted support of surveillance of pests, diseases, etc.)
Convince managers that projected changes will impact upon their enterprise	Policies that support the research, systems analysis, extension capacity, industry, and regional networks that provide this information could thus be strengthened. This includes modelling techniques that allow scaling up knowledge from gene to cell to organisms and eventually to the management systems and national policy scales.
Support increased access to technical and other innovations	Where existing technical options are inadequate, investment in new technical or management strategies may be required (eg, improved crop, forage, livestock, forest, and fisheries germplasm), including biotechnology. In some cases, old approaches can be revived that may be suited to new climate challenges.
Effectively plan for and manage climate-induced transitions in land use	Transitions of land use may include migration, resettlement and industry relocation. Provide direct financial and material support, creating alternative livelihood options with reduced dependence on agriculture, supporting community partnerships in developing food and forage banks, enhancing capacity to develop social capital and share information, retraining, providing food aid and employment to the more vulnerable, and developing contingency plans. Effective planning and management may result in less habitat loss, less risk of carbon loss and also lower environmental costs compared with unmanaged reactive transitions.
Support new management and land use arrangements	Enable new management and land use arrangements via investment in new infrastructure, policies, and institutions. <ul style="list-style-type: none"> • Addressing climate change in development programmes; • Enhancing investment in irrigation infrastructure and efficient water use technologies; • Ensuring appropriate transport and storage infrastructure; • Revising land tenure arrangements, including attention to property rights; • Establishing accessible, efficient markets for products and inputs (seed, fertiliser, labour, etc.) and for financial services, including insurance.

Source: Adapted from Howden *et al.* (2007).

further examples as referenced (Reid *et al.* 2010). Key themes include: addressing vulnerability, natural-resources management, community adaptation, communication and scaling up, cross-cutting issues, insurance and microfinance, and value-chain approaches.

4.5.3 AAS and climate change mitigation

Smallholders may be able to access significant levels of payments for the environmental services that they provide. Indeed, they may even be paid for maintaining low external-input farming systems that were in the past discouraged. Low-carbon agriculture may mean modifications to existing production systems through, for example, minimum tillage methods and organic farming. It is now generally recognised that society has a debt to farmers to pay for (and presumably subsidise) these activities.

There is as yet little consensus about how to undertake such payments on the massive scale that is required, or of how to address national and global food security where mitigation measures reduce overall production levels. Concerns about GHG emissions may have a direct negative impact on agricultural trade. Farmers in low- and middle-income countries are losing access to markets due to climate change mitigation efforts as consumers in wealthier countries are being encouraged to shun products that require long-distance transport. Agricultural research can support evidence gathering as to the actual GHG emissions generated by different types of production and trade – transport is less of an issue than first thought, for example, in comparisons of green bean value chains from Kenya and the Netherlands to the UK. Further, they can support farmers to understand the different markets they might seek to access, and

Box 18: Examples of adaptation activities involving AAS in Africa

Theme	Examples
Addressing vulnerability	
	<p>Strengthening organisations to provide voice to vulnerable people to influence adaptation planning and implementation (Centre for Environmental Policy and Advocacy, Malawi)</p> <p>Capacity Strengthening in the Least Developed Countries on Adaptation to Climate Change (CLACC) programme initiated by the International Institute for Environment and Development (IIED)</p> <p>Child-centred adaptation and disaster risk reduction (DRR): lessons from Mozambique (Save the Children)</p>
Natural-resources management	
Agricultural practice and management	<p>Farmer field school approach to developing climate change adaptation strategies by farmers and government in the Agricultural Services Support Programme and the Agricultural Sector Development Programme-Livestock (ASSP/ASDP-L) Zanzibar, Tanzania</p> <p>In Senegal, UNDP and the government are in the process of developing a project 'Supporting Integrated and Comprehensive Approaches to Climate Change Adaptation in Africa'</p> <p>The NGO Environmental Development Action in the Third World (ENDA-TM) is addressing food insecurity in Maradi, Niger, building a sustainable partnership and working closely with local communities in a participatory manner</p>
Water-resources management	<p>Climate change vulnerability assessments for water-focused projects by Global Water Initiative (GWI) in Ethiopia, Uganda, Kenya and Tanzania. IUCN and CARE International</p> <p>Africare projects in Zimbabwe supporting farmers to cope with drought</p> <p>Indigo Development and Change project supporting smallholder farmers in Suid Bokkeveld, South Africa to cope with water scarcity</p> <p>Malawi Ministry of Irrigation and Water Development projects to improve local-level water management</p>

Theme	Examples
Community adaptation	
Community-based adaptation methodologies and toolkits	<p>In Ghana, CARE conducted a review using their ‘Toolkit for Integrating Adaptation into Projects’ as part of their existing Local Extension Services for Agricultural Development (LEAD) project</p> <p>IUCN undertook a climate change vulnerability assessment in four villages of lower Rufiji, Tanzania using the Community-based Risk Screening Tool – Adaptations and Livelihoods (CRiSTAL)</p> <p>Participatory video monitoring and evaluation work in Kenya and Zimbabwe through the community-based adaptation programme (InsightShare)</p>
Community-based adaptation & DRR	<p>Oxfam’s Emergency response and disaster risk reduction project aims to strengthen their support for humanitarian preparedness and response in Nigeria through promoting stronger coordination of humanitarian actors at national, state and local levels</p> <p>The Strengthening Climate Resilience (SCR) project, in partnership with the African Climate Change Resilience Alliance (ACCRA), seeks to increase resilience to climate change among vulnerable people by enhancing the ability of governments and civil society organisations to manage disaster risk and uncertainties more effectively</p> <p>Enhancing Adaptive Capacity of Pastoralists to Climate Change in Northern Kenya was a 2-year project implemented by Practical Action</p>
Community-based adaptation in urban areas	<p>The Universities of Dar es Salaam and Malawi are working with AAS organisations in Tanzania and Malawi exploring urban–rural social and environmental inter-dependence and impacts of climate change</p>
Communication and scaling up	
Managing and communicating knowledge about good community-based adaptation	<p>Oxfam GB has been working in collaboration with weADAPT since mid-2009 to design a suitable online knowledge base and web platform for learning</p> <p>AfricaAdapt is an independent bilingual network (French/English) focused exclusively on ‘Africa’</p> <p>New climate change programmes produced by the Malawi Development Broadcasting Unit (DBU)</p> <p>Vodafone Ghana, in collaboration with EPA, has launched a project called ‘Integrating Climate Change into Telecommunication Industry’</p> <p>Farm Radio Programme Climate Change Adaptation Goes Soap: Using radio drama to share ways smallholder farmers in Nigeria can adapt to a changing climate</p>
Scaling up and replicating best practice	<p>Addressing climate change throughout the programme cycle, Oxfam</p> <p>The Relief Society of Tigray (REST) promotes various water-harvesting technologies to address water availability for agriculture and households as critical enabling factors for adaptation in collaboration with local community institutions and governments</p> <p>Practical Action’s ‘Greening Darfur’ programme is aiming to build adaptive livelihoods</p>

Theme	Examples
Cross-cutting issues	
Strengthening adaptive capacity	<p>In Benin, the project ‘Strengthening the Capacity to Adapt to Climate Change in Rural Benin’ is being implemented by the NGO IDID</p> <p>The Ogaden Welfare and Development Association (OWDA) work supports the adaptive capacity of pastoralists to enable them to withstand the natural and anthropogenic shocks affecting their lives</p> <p>In Niger, the government’s National Environment Council for Sustainable Development (SE/CNEDD), in the Office of the Prime Minister is to implement the Pilot Program for Climate Resilience (PPCR)</p>
Insurance/ microfinance	<p>Malawi: Weather-based crop insurance programme supported by FAO through a World Bank project</p> <p>The Horn of Africa Risk Transfer for Adaptation (HARITA) pilot project brings together subsistence farmers, NGOs, academics, government and the private sector to explore an innovative approach to community-based climate change adaptation in Ethiopia</p> <p>Kilimo salama Kenya Crop Insurance Programme – smallholder farmers pay a small insurance premium on their purchase of seeds or fertiliser</p>
Role of ecosystems in adaptation	The WWF’s Madagascar and Western Indian Ocean Programme Office is currently implementing a number of ecosystem-based adaptation activities
Value-chain approach to climate change adaptation	In Ghana, the Ministry of Food Security and Agriculture and the Environment Protection Agency have a project ‘Promoting Value Chain Approach to Adaptation in Agriculture’

help them in providing advice related to different forms of certification and labels. AAS can also help farmers to demonstrate the environmentally friendly qualities of their products and thereby mitigate some of the potentially negative impacts of climate change mitigation efforts.

Another area where strong AAS activities are needed is in informing farmers about new regulatory and certification structures related to organic production, payments related to REDD+, and other future mechanisms that have yet to be created. AAS can increase awareness about how to minimise environmental impacts, maximise carbon sequestration and thereby reduce the costs that farmers have in complying with new regulatory frameworks. It is important to note, however, that there is a risk that AAS organisations may be tasked with inappropriate responsibilities to monitor and even enforce these regulations. This could severely damage the trust that must exist between service providers and their clients.

Finally, there are *potential synergies between climate change adaptation and mitigation*. AAS organisations can play a role in achieving these synergies. Low-carbon alternatives for agriculture can reduce risk by reducing dependence on capital inputs in the form of agrochemicals and may also reduce demands on increasingly strained water resources. Some minimum-tillage farming methods and measures to restore degraded lands can both reduce GHG emissions and reduce run-off, flooding, erosion and landslide risks in the event of heavy rains or drought. Farming

methods that increase carbon storage can also enhance moisture retention. Certification may provide an extra price premium on products that are more adaptable to climate variability, but which would otherwise be unattractive due to lower productivity. In all of these areas, AAS has a role to play in informing farmers about the changing sets of incentives for different choices in agricultural management (Christoplos 2010a).

Table 10 shows a selection of existing payment for ecosystem services (PES) projects in Africa that are focused on carbon sequestration (see Appendix 8 for more details). Two lessons are emerging: (1) a good aggregator (ie, an entity that coordinates the providers or sellers of carbon credits) is essential, especially one that can also advise on agricultural practices; (2) the method for monitoring must be simple and accessible and transparent to the farmer (World Bank 2010a).

Mitigation policy responses are also creating challenges and opportunities in the agricultural sector. As legislation is starting to require use of biofuels, pushed in part by mitigation imperatives, the demand for biofuel production is increasing (see Table 11). AAS organisations have an important role to play in advising farmers and other actors on this issue. It will be important to have AAS organisations that have the capacity to provide a wider perspective on biofuels and the enterprises that are creating opportunities for smallholder farmers. For example, the Malawian company BERL is planning to: (i) initiate an extensive tree-planting programme through existing extension agents, smallholder and commercial farmers ; (ii) purchase seed through contracts with smallholder growers and commercial growers; (iii) expel and clean crude oil for use as biofuel; (iv) develop and offer to the market various by-products to add value to the production process, including organic fertiliser and bulk compost; and (v) offer technical services to interested parties who would like to promote an additional, secure cash crop to the rural communities at grassroots level. A specific objective of BERL is that *Jatropha curcas* will be grown in a responsible

Table 10: Examples of carbon initiatives involving smallholders in Africa

Country	Projects	Intermediary
Tanzania	Tanzania Emiti Nibwo Bulora (Trees sustain life) ww.planvivo.org/?page_id=2418	VI Agro-Forestry NGO
	TIST – The International Small Group and Tree Planting Programme ww.tist.org/tist/tanzania.php	TIST (NGO)
Ethiopia	Humbo Assisted Regeneration http://wbcarbonfinance.org/Router.cfm?Page=Projport&ProjID=9625	World Vision NGO
Uganda	Trees for Global Benefits http://planvivo.org.34spreview.com/?page_id=45	ECOTRUST (Environmental Trust of Uganda) NGO
Kenya	Smallholder Coffee Carbon Project http://siteresources.worldbank.org/INTARD/Resources/335807-1236361651968/Timm_RWsideevent.pdf	ECOM Agroindustrial Corporation
	Green Belt Movement http://wbcarbonfinance.org/Router.cfm?Page=Projport&ProjID=9635	Green Belt Movement NGO
	Agricultural Carbon Project http://wbcarbonfinance.org/Router.cfm?Page=BioCF&FID=9708&ItemID=9708&ft=Projects&ProjID=58099	VI Agro Forestry NGO
Mali	Acacia Senegal Plantation Project http://siteresources.worldbank.org/INTARD/Resources/3358071236361651968/Timm_RWsideevent.pdf	Degeussi Groups (private company) with technical support from ICRAF and ICRISAT

Table 11: Biofuel production by country, 2007

Country/country grouping	Ethanol		Biodiesel		Total	
	(million litres)	(Mtoe)	(million litres)	(Mtoe)	(million litres)	(Mtoe)
Brazil	19,000	10.44	227	0.17	19,227	10.60
Canada	1,000	0.55	97	0.07	1,097	0.62
China	1,840	1.01	114	0.08	1,954	1.09
India	400	0.22	45	0.03	445	0.25
Indonesia	0.00	0.00	409	0.30	409	0.30
Malaysia	0.00	0.00	330	0.24	330	0.24
USA	26,500	14.55	1,688	1.25	28,188	15.80
EU	2,253	1.24	6,109	4.52	8,361	5.76
Others	1,017	0.56	1,186	0.88	2,203	1.44
World	52,009	28.57	10,204	7.56	62,213	36.1

Mtoe, million tonnes of oil equivalent.

manner. These cultivation models aim to avoid competition with food (ie, no competition for land and labour), to minimise negative impacts on biodiversity, to minimise negative impact on natural resources, and to stimulate local development. They also seek to ensure positive labour conditions and will not allow the use of genetically modified organisms. BERL proposes to use internationally accepted standards for carbon credit certification²¹ and to ensure sufficient CO₂ reduction (www.berl.biz).

5. New and additional funding opportunities in response to climate change

The increased recognition by the international community of the need to respond to climate change has created some new funding opportunities from both public and private sources for AAS. These may be broadly divided into funds for addressing adaptation and those focused on climate change mitigation (Tables 12 and 13).

Table 12: Emerging funding related to climate change issues

Sector	Adaptation	Mitigation
Public	Least Developed Countries Fund Special Climate Change Fund	World Bank BioCarbon Fund (public and private)
Third sector	International NGOs beginning to raise funds	International NGOs beginning to raise funds
Private	Private company investments	Carbon market funds (Voluntary and Regulated)

Table 13: Existing instruments of climate finance

Type of instrument	Mitigation	Adaptation	Research, development and diffusion
Market-based mechanisms to lower the costs of climate action and create incentives	Emissions trading (CDM, JI, voluntary), tradable renewable-energy certificates, debt instruments (bonds)	Insurance (pools, indexes, weather derivatives, catastrophe bonds), PES, debt instruments (bonds)	
Grant resources and concessional finance (levies and contributions, including official development assistance and philanthropy) to pilot new tools, scale up and catalyse action, and act as seed money to leverage the private sector	GEF, CTF, UN-REDD, FIP, FCPF	Adaptation Fund, GEF, LDCE, SCCF, PPCR and other bilateral and multilateral funds	GEF, GEF/IFC Earth Fund, GEEREF
Other instruments	Fiscal incentives (tax benefits on investments, subsidised loans, targeted tax or subsidies, export credits), norms and standards (including labels), inducement prizes and advanced market commitments, and trade and technology agreements		

Source: World Bank (2010a).

CDM = Clean Development Mechanism; CTF = Clean Technology Fund; FCPF = Forest Carbon Partnership Facility; FIP = Forest Investment Program; GEEREF = Global Energy Efficiency and Renewable Energy Fund (European Union); GEF = Global Environment Facility; IFC = International Finance Corporation; JI = Joint Implementation; LDCE = Least Developed Countries Fund (GEF); PPCR = Pilot Program for Climate Resilience; SCCF = Special Climate Change Fund (GEF); UN-REDD = UN Collaborative Program on Reduced Emissions from Deforestation and forest Degradation.

Unfortunately, current levels of funding forthcoming for climate finance fall far short of estimated needs – *total climate finance* for developing countries is \$10 billion a year, compared with projected annual requirements by 2030 of \$30–100 billion for adaptation and \$140–175 billion for mitigation. Filling the gap requires reforming existing carbon markets and tapping into new sources, including carbon taxes. Pricing carbon will transform national climate finance, but international financial transfers and trading of emission rights will be needed if growth and poverty reduction in developing countries are not to be impeded in a carbon-constrained world (World Bank 2010a).

Several studies have recently made preliminary estimates of the costs of adaptation and concur that climate change is both ongoing and that further significant impacts are now inevitable. Furthermore, the costs of adaptation are difficult to estimate, as they depend on many factors, including mitigation scenarios and the timing and manner in which adaptation measures are locally implemented, but the costs will be high.²²

Adaptation costs incurred by developing countries in responding to the adverse effects of climate change are an additional burden. The term ‘additional costs’ was adopted and defined as the ‘*costs imposed on vulnerable countries to meet their adaptation needs due to the adverse impacts of climate change*’ (GEF 2010b). The Least Developed Countries Fund (LDCF) and the Special Climate Change Fund (SCCF) are key funding sources for adaptation (GEF nd).

Specifically focusing on climate finance for Africa, the African Forum on Financing for Development, organised by the UN Economic Commission for Africa (UNECA), reviewed progress in collaboration with development partners in May 2011.²³ Key themes covered at the forum were: mobilising public finance and managing natural-resource revenues; accessing climate change finance for development in Africa; mobilising resources for financing infrastructure and structural transformation in Africa; tackling illicit capital flows for economic transformation in Africa; harnessing South–South cooperation for financing development in Africa; innovative sources of development finance for Africa; enhancing microfinance for Africa’s development; and reforms of the international financial architecture and its impact on African development process.²⁴

At the forum, Patrick Berg, of Heinrich Böll Stiftung, Ethiopia estimated that 92 percent of climate finance in 2010 was still directed towards mitigation activities. Speaking in the same session, Lloyd Chingambo, Chairman, Africa Carbon Credit Exchange, suggested that Africa should consider adopting an aggressive ‘twin’ climate financing strategy that separates and develops independent, though complementary, approaches – external climate change financing sources and internal climate change financing sources – with the strategy being anchored and driven by the internal financial sources.

Carbon markets

Carbon markets are derived from an appreciation of the need to control/reduce the global build up of GHGs in the atmosphere, which is resulting in global warming and climate change. The two main options are for entities to reduce their own GHG emissions or to offset these by paying for emissions to be reduced by others elsewhere. The latter option has created markets for GHGs (the four GHGs carbon dioxide, methane, nitrous oxide, sulphur hexafluoride, and two groups of gases, hydrofluorocarbons and perfluorocarbon), which are traded as carbon dioxide equivalents.

There are two main types of markets: the regulated/compliance market and the voluntary market. The regulated markets emerged from the Kyoto protocol²⁵ under which 37 Annex 1 countries have entered into a legally binding agreement to reduce their aggregate annual GHG emissions by 5.2 percent in 2008–2012 compared to the reference year of 1990. These markets are based on a cap-and-trade model with three major ‘flexibility mechanisms’: Emissions Trading, the Clean Development Mechanism (CDM), and Joint Implementation (JI). These mechanisms are the basis of the regulated international Kyoto carbon market.

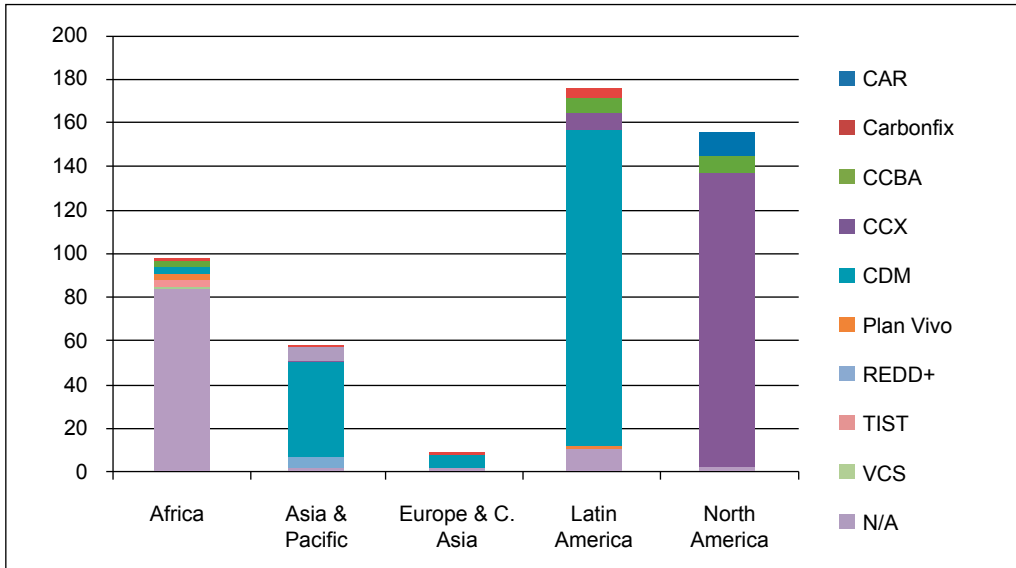
Kyoto Parties can use land use, land use change, and forestry (LULUCF) in meeting their targets. Forest management, cropland management, grazing-land management, and revegetation are all eligible LULUCF activities under the Protocol. However, the opportunities in developing countries are currently very limited. The CDM allows for the implementation of LULUCF project activities, but is limited to afforestation and reforestation in non-Annex 1 countries. Such land-use-based carbon credits represented only 1 percent of 4968 CDM projects and only 0.1 percent of 2063 registered projects as of March 2010 (World Bank 2010b). Improved management of manure to reduce methane emissions is also eligible under the CDM and 182 such projects were identified by the FAO Mitigation of Climate Change in Agriculture (MICCA) project in 2010 (Varming *et al.* 2010). Critically, LULUCF projects are completely excluded from the EU Emissions Trading Scheme (by far the biggest regulated market).

In 2010, the international carbon markets transacted 6,823 Mt CO₂e, valued at \$124 billion. The voluntary markets contributed just a small fraction of volume (131 Mt CO₂e) and value (\$424 million) (about 1.9 percent of volume and 0.3 percent of value), the rest of which was seen in the regulated markets (Hamilton *et al.* 2010; Peters-Stanley *et al.* 2011).

Although the voluntary carbon market is much smaller than the regulated/compliance market, there are much greater opportunities for LULUCF activities. Voluntary markets are used by individuals and organisations (public and private) to offset their emissions. The motivation for doing so varies from CSR to marketing to philanthropy (Hamilton *et al.* 2010). Some of the schemes have multiple objectives and aim to achieve social as well as other environmental benefits (eg, Climate, Community and Biodiversity Alliance (CCBA), Plan Vivo). Others are more similar to the CDM, but with different selection criteria and standards (eg, Verified Carbon Standard [VCS], Gold Standard).

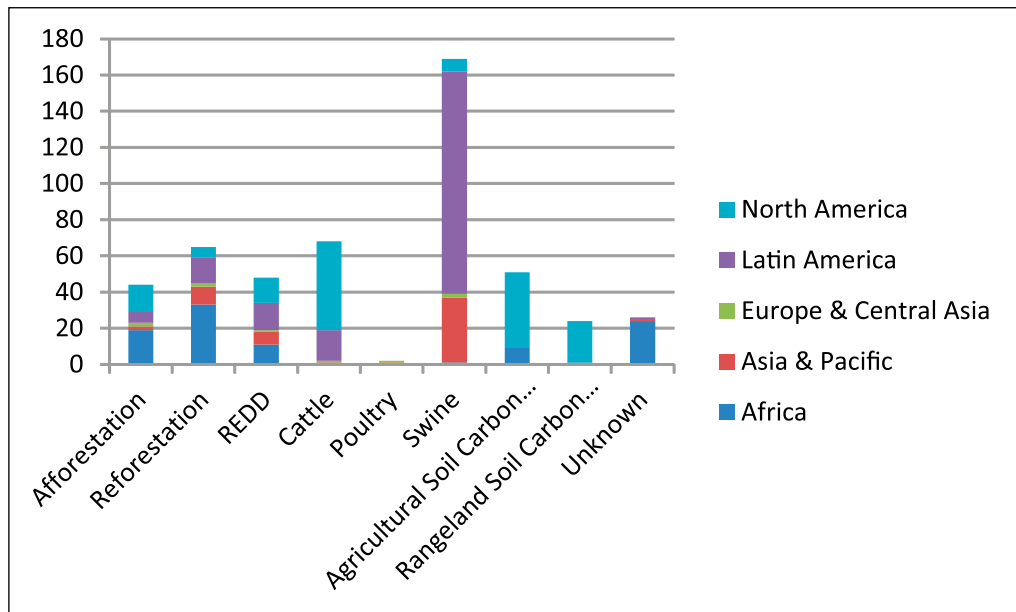
Varming *et al.* (2010) identified 497 mitigation projects (Figures 9 and 10) falling in the category ‘agriculture, forestry and other land use’ (AFOLU). About one-fifth of these projects were not part of any crediting scheme. Almost 40 percent were first registered under the CDM, although almost all of these were concerned with improved management of manure to reduce methane emissions. Almost 30 percent of the projects were first registered under the Chicago Carbon Exchange (CCX) and included soil carbon, forestry and manure-management projects. The other projects were registered under various other voluntary carbon schemes.

The majority of AFOLU projects are based in Latin America (35 percent of projects) and North America (31 percent of projects) (Varming *et al.* 2010) (see Figure 9).²⁶ The 10 African soil carbon projects (Senegal, 5; Mauritania, 1; Madagascar, 2; Kenya, 1; Sudan, 1) reported by Varming *et al.* (2010) all appear to be outside carbon-trading schemes. However, the first ever African soil carbon deal was signed in November 2010, which should bring benefits to Kenyan farmers through the World Bank Biocarbon Funds (Hagbrink and Bisset 2010).



Source: data from Varming *et al.* (2010).

Figure 9: AFOLU projects by region and carbon trading scheme



Source: data from Varming *et al.* (2010).

Figure 10: AFOLU projects by region and project type

The implementing organisation (project developer) may or may not be the land steward, and a wide range of arrangements appears to be emerging. Development and conservation NGOs may be the project developer. For example, World Vision has developed a project in Ethiopia converting 503 ha of grassland and cropland to forest, targeting 3000 farmers. Conservation

International (with Toyota Motor Corporation) is working with 1000 farmers in the Philippines converting 2943 ha of grassland and cropland to forest. Agro-industrial companies in the USA are establishing carbon credits through capturing methane in their cattle enterprises. Similarly, specialist EU-based companies are collaborating with large-scale Latin American pig-rearing agro-enterprises. North Dakota Farmers Union (NDFU) reports that it helped 3900 participating farmers and ranchers to access \$7.4 million between 2005 and 2010 through selling soil carbon credits on the CCX(<http://carboncredit.ndfu.org>). However, the CCX has now ceased trading and so the NDFU reports that it is monitoring markets and regulations to search for opportunities that provide farmers with financial incentives for voluntarily reducing carbon emissions.

Examples of carbon initiatives involving smallholders in Africa are shown in Table 12 (p 87) and details are given in Appendix 8.



6. Conclusions and recommendations

The agricultural context is dynamic, heterogeneous and complex, with increasing local–global social and environmental interactions. Climate change is contributing to and exacerbating an already risky and uncertain SSA agricultural context. Agriculture is also contributing to climate change – at a particularly fast rate in developing countries. Food insecurity and poverty are generally recognised as extremely significant problems in SSA, but how the questions around these issues are framed – let alone the possible solutions – vary among diverse stakeholders. The framing assumptions are critical in that they shape agendas and steer perceived solutions, programme designs and resources in certain direction and not others. Climate change is leading to a revisiting of some of these assumptions to understand what might be appropriate in very different and diverse ‘rural worlds’. Production-innovation and growth narratives, for example, are prevalent, but are increasingly challenged by those reviewing outcomes in the light of resilience to climatic (and other) shocks and stresses – particularly outcomes for vulnerable groups. This is the challenging context in which AAS individuals and organisations are expected to perform.

There is increasing agreement that individuals and organisations need to develop adaptive capacity in order to respond to increasing pressures, to identify potential pathways over longer time periods and to consider the equity implications. Adaptive management is an approach to guide intervention in the face of uncertainty – something which is likely to increase with climate change. The principal idea is that management actions are informed by explicit learning from policy experiments and the use of new information and technical knowledge to improve understanding, inform future decisions, monitor the outcome of interventions, and develop new practices. Adaptive management has a long time horizon for planning and capacity strengthening, and is aligned with ecological processes at appropriate spatial scale. It creates an enabling framework for cooperation among administrative levels, sectors, and line departments; broad stakeholder participation in problem solving and decision making; and adaptable legislation to support local action and respond to new information.

Adaptive AAS will have to develop in three ways to respond to climate change: develop the capacity to manage risk and uncertainty; recognise and embrace the plurality of AAS; and respond to change and unpredictability. Additionally, it should also achieve the following objectives to successfully support adaptive capacity in rural communities: (i) increasing the availability of key livelihood assets; (ii) an equitable institutional environment, including attention to gender and social inclusion; (iii) improving the ability to collect, analyse and disseminate knowledge and information in support of adaptation activities; (iv) achieving an enabling environment fostering innovation, experimentation and niche solutions; and (v) the

ability to anticipate, incorporate and respond to changes with regards to governance structures and future planning.

The extent to which an AAS can function effectively and in an adaptive manner is influenced by the context and drivers of AAS, and by the vision and governance, management, capacity and advisory methods used.

6.1 Context and drivers of AAS

To achieve a climate-friendly institutional and policy environment for agricultural development first of all requires mainstreaming of climate change awareness across government policies and may require changes in planning timescales and reviews of operating assumptions. Climate change is increasingly emphasised in global environmental agreements, national environmental policies and national climate change plans on mitigation and adaptation, which tend to fall under the aegis of environment ministries. But there is often a policy disconnect between climate policy and other government policies. Further, there are often implementation challenges, in terms of a lack of capacity and coordination – sometimes because of the relative power of the responsible ministry. All AAS sectors are strongly influenced by policy decisions made at local, national and global levels, and more attention should be paid to the political economy of decision making in relation to AAS investment, priorities and methods. Often the decisions taken tend towards a shorter-term perspective. This is at odds with a need to address longer-term climate change issues. The wide diversity of ‘rural worlds’ supports the need for localised solutions and innovation, informed by access to wider-scale information and partnerships.

While broad climate change projections are available, there are major uncertainties about actual impacts. For AAS to respond to climate change, individuals and organisations need a broad understanding of climate science, projections and impact models, other forms of climate knowledge, and of vulnerability and adaptive capacity assessments.

There is a relatively small proportion of land under agriculture in SSA, but there is increasing recognition of the wider ecosystem-services function of grassland and forests, as well as agricultural landscapes themselves. The wide diversity of agro-ecologies suggests a need for localised solutions and innovation, but informed by local, national and global information and partnerships. The need to explicitly address uncertainty also suggests a need for flexible organisations, organised to respond to ecological processes at appropriate scales and in an integrated manner, and to move away from control-oriented options to more adaptive, locally rooted ones. Scaling up is required if the latter approach is to have a significant impact. Further investment is thus required and should be sought from climate finance sources.

Agriculture is increasingly being expected to deliver on multiple objectives, including global food production, climate resilience, reduction of greenhouse gases and, of late, protection or improvement of other ecosystem services. To achieve all of these goals simultaneously is a significant challenge. The potential overlap between adaptation and mitigation options has been widely discussed. The synergies between them need to be identified and supported by AAS.

But it is important to recognise that climate change will make it harder to produce enough food for Africa and the world’s growing population. To avoid expansion into other ecosystems,

agricultural productivity will have to increase, while minimising the associated environmental damage and with net reductions in GHG emissions from food production and postharvest activities. Crop yields have not increased in SSA and increases in production have mainly been through conversion of forest and grassland to farmland, with consequent loss of environmental services. Improvements in productivity are therefore crucial, but a conventional, high external-input approach to production-innovation and growth maximisation, seems increasingly unlikely as a viable pathway in economic as well as social and environmental terms. A number of governments are addressing the limited input use by farmers through input subsidies. However, farmers and other actors have limited ability to diagnose locally specific input requirements. Further, such locally appropriate inputs are often not available and target groups often do not have access to these subsidised inputs. Subsidising inputs places a heavy demand on government budgets with few funds remaining for learning-based AAS operations. There is a need to re-assess the production-innovation and growth models from a climate-resilience perspective. While agricultural productivity needs to increase for food-security reasons and to protect other ecosystems, it is essential to recognise that there are diverse rural situations and in some cases or for some groups it may be more important to prioritise climate-resilience and equitable food-security solutions, rather than maximising productivity.

An alternative approach would be to strengthen the ability of farmers to diagnose their own production constraints such as soil fertility and diseases, as well as gender and power inequalities, and to work with enterprises to develop locally appropriate inputs and make them available in an appropriate way (eg, small packs) to allow farmers to experiment. There is widespread agreement that improving access to seed and management of agro-biodiversity have a crucial role in strengthening adaptive capacity, but there are differing views on the role and importance of formal versus informal seed systems. For example, some actors put their faith in the development of modern varieties which have particular traits to address climate constraints such as drought tolerance, while others emphasise the importance of traditional or local seed systems. Both of these linked systems have a crucial function in current and future food systems, and AAS have a key role to play in strengthening these systems to improve adaptive capacity.

The relationship between trade, climate change, food and different agricultural development pathways is complex and there are widely differing views on the subject. Climate change is likely to alter countries' comparative advantages in agriculture, and thereby lead to shifts in the patterns of international trade. Climate change is also expected to impact on infrastructure and transport routes. Countries where climate change creates scarcity may meet their needs by importing and, in the case of food, this is likely to be from mid-high latitude areas (eg, parts of North America, northern Europe) to lower latitudes (eg, much of Africa). Studies suggesting that agricultural trade facilitates adaptation and brings global welfare benefits emphasise the importance of removing trade distortions (eg, subsidies). However, others point out that adaptation in developing countries through increasing trade would be severely constrained by limited buying power. The response to climate change is creating new markets for farmers (eg, biofuels, the carbon market). Climate change as an issue is increasingly being addressed by social and environmental certification and labelling schemes. This could potentially affect both existing and potential future producers by excluding them due to the stringency of requirements. There is a need for increased knowledge of how adaptation can be supported through the development of and support for different types of value chains and business

models – particularly the opportunities but also the risks for producers with less adaptive capacity or that face gender discrimination. The changing world of CSR and certification offers both opportunities and constraints.

Africa's population is increasing rapidly and becoming increasingly urbanised, but in 2030 most people and the majority of the poor in SSA will still be living in rural areas. The rural population will be most vulnerable to climate change impacts and other stresses. Food security and wider livelihood needs are largely dependent on agriculture and natural resources, and are likely to be so for another generation. It is important that scenario-building exercises are undertaken, engaging diverse sets of stakeholders, to understand the range of potential future pathways for agricultural development.

6.2 AAS characteristics

Visions of agricultural development vary, but there are prevalent notions of agricultural production-innovation and growth, although climate resilience and mitigation imperatives, as well as broader protection of ecosystem services, are gaining greater recognition.

There is an increasing recognition and plurality of actors from the public, private and third sectors in both the provision and funding of AAS. In all three sectors, visions of success appear to have relatively short-term horizons. In the public sector this is driven by political necessity, in the third sector often by funding-agency timelines, and in the private sector the need to secure profit. There are exceptions, including the 2020 and 2025 vision processes led by the public sector, various climate change alliances in the third sector, and in the private-sector organisations motivated by CSR and various forms of certification. The majority of funding from all sectors appears to be striving for short-term success with only lip service paid to longer-term sustainability and strengthening of adaptive capacity. Strengthening physical infrastructure is an example of a longer-term perspective. Poverty reduction, gender and social protection policies may highlight equity issues, but exactly how they are prioritised, interpreted and implemented by AAS varies between AAS sectors and countries.

Views differ about the relative importance of strengthening farmer organisation and capacity. Many organisations in the third sector, including larger farmer organisations, aim to strengthen farmers' organisational capacity and agency as a means of strengthening their collective action to negotiate, advocate, secure rights, etc. In the private sector, the motives vary from the need to secure produce on a regular basis to ethical-trade concerns. Public-sector organisations are in most cases now working with farmer groups as a cost-effective way of delivering AAS, but generally empowerment does not appear to be a major motive.

Government agricultural and environmental policy statements generally emphasise the need to embrace scientific or more formal knowledge and associated technology. In relation to seed, for example, although most farmers in SSA are dependent on informal seed systems, most policies are geared towards the development and promotion of modern varieties. This is in spite of the recognition of the importance of agro-biodiversity in adapting to climate change and global agreements on the importance of biodiversity conservation and sustainable use. Most private-sector organisations tend to value scientific knowledge more strongly, whereas the third sector has tended to place more value on local people's knowledge than the other two sectors.

AAS organisations or individuals have an implicit vision of agriculture, innovation and the role of different actors. The dominant narrative tends to view agricultural innovation as a driver of productivity, economic growth and hence poverty reduction. In most, if not all countries, public policy on agricultural innovation does not look beyond high-input, high-energy, high-water use. Some organisations in the third sector and some individuals in all sectors appear to be embracing alternative, less-resource-intensive visions of agriculture and innovation. UNEP (2011) suggests a decoupling of economic growth from high resource use through a 'green economy' approach. Many green-economy innovations and low-carbon technologies may well come from the developing world.

National environmental policies generally embrace UN agreements on, eg, biodiversity, desertification and climate change. However, with regard to agriculture, CAADP and national policies prioritise maximisation of productivity and implicitly this means resource-intensive farming, in some cases highly subsidised by governments – yet this may not be appropriate in all situations and has costs in terms of environmental impact. The third sector probably has the most interest in adapting to change through alternative innovation, but probably has the least capacity.

It seems that many aspects of AAS management are not yet 'adaptive'. **Adaptive management** is an approach to guide intervention in the face of uncertainty (see paragraph 2 of these conclusions). Some of the recommendations above already address these requirements.

Our study has found that it is mainly NGOs that have explicitly addressed the issue of strengthening farmers' adaptive capacity to date, although examples are found in the public and private sectors. However, many funding agencies – although apparently striving for sustainable change – still effectively prioritise shorter-term impact, at times at the expense of longer-term capacity strengthening. It is important to recognise and seek strategies for responding to the political-economy drivers that influence decision making in AAS that, in many cases, represent real barriers to change on the ground.

NGOs have tended to take the lead among AAS organisations in terms of targeting different groups (eg, the more vulnerable), although this is becoming more common in public sector AAS – including in response to climate change vulnerability, as well as generic pre-existing patterns of poverty. Typically, public- and third-sector M&E systems are project based. It is increasingly common that public- and third-sector M&E systems measure performance in terms of improving access to and control of assets by different groups. However, pressure to demonstrate short-term impact creates an incentive to work with groups with more assets and focus on shorter-term livelihood impacts. Evaluations rarely assess the actual longer-term impacts. More attention is needed in formulating methodologies and indicators for evaluating the impact of agricultural adaptation. It is likely that assessment will comprise a composite of existing development indicators and specific adaptation ones.

In comparison to the bureaucracy of the public sector, the private sector is usually credited with greater freedom and incentives to change quickly in response to changing market conditions, and rewards for localised innovation should be greatest in the private sector. However, in the agribusiness sector there appears little evidence of innovation. For example, a common approach among agri-input enterprises appears to be to take technology from elsewhere and to try to sell it with little consideration of tailoring it to the local context.

With respect to climate change, market signals are not yet that strong – awareness of adaptation challenges are only just being heard in some sections of the private sector. Mitigation incentives are increasing for reasons of reputation, but also because of moves towards legislation and emergence of carbon-offset schemes with greater credibility.

In the public and third sectors, the major incentive to adapt to climate change and uncertainty seems to relate to the funding situation. Few organisations in any of the AAS sectors appear to have management systems which reward changes in response to these pressures. Exceptions include NGOs that have an environmental and agricultural aim (eg, WWF UK) and private companies involved in organic agriculture or other environmentally focused certification schemes.

Increasing the **capacity of service providers** and partners to respond to climate change is a priority. State AAS has been generally neglected until very recently. Several new factors are influencing investment in agriculture – namely, increasing recognition of climate change, food-security concerns, rising food prices and volatile energy prices, the peak in global oil production, and appreciation of the limited availability of natural resources and the tipping points that exist in complex, adaptive ecosystems which can be breached with serious consequences requiring greater resilience to shocks and stresses. These factors have contributed to increases in investment by some countries and donors.

NGOs have maintained a relatively strong presence in agriculture and some have taken lead roles in community-based adaptation issues in particular (eg, CARE International, Oxfam, Practical Action). Some others have been more active in mitigation efforts (eg, World Vision; VI AgroForestry; Farm Africa). Information on the private sector varies, but overall information is limited.

In order to strengthen farmers' adaptive capacity, AAS organisations need to be able to explore different scenarios with farmers and other AIS actors. The facilitation skills and some of the concepts to do this are currently more likely to be found in the third sector, but overall knowledge and skills in this area are almost certainly very limited.

Adaptive capacity varies widely between individuals and communities due to differing access to and control of assets and the institutional environment in which people are living. Gender and social inequality are prevalent in all societies in terms of resource distribution, and gender and social norms limit the participation of women and marginalised groups in decision making. Climate change direct impacts may worsen these inequalities, and adaptation and mitigation interventions may also have negative effects and miss opportunities if they are gender blind. In order to strengthen adaptive capacity, AAS organisations need to be able to recognise these differences and inequalities and develop strategies to address them. This has tended to be a focus of some NGOs in the third sector, although there is increasing recognition in some public-sector organisations. Private-sector capacity and motivation depends on the type of organisation.

Self-organisation is a key element of adaptive capacity. This again has tended to be a strong point of the third sector, including farmer organisations themselves. There is increasing capacity in some public-sector organisations, although it remains an open question to what extent public AAS can play this role. Private-sector capacity and motivation again depends on the type of organisation.

Climate change has emerged only recently as a critical issue and so most AAS individuals would have received little or no specific training in relation to climate change in their formal training. In addition to this, most African training organisations have little current capacity in this area. Accessing and using knowledge and information in general has certainly been an issue for most public AAS organisations, which have often tended to be passive recipients of information (usually from public-sector research). This is starting to change, but many AAS actors have limited capacity to actively seek and use new knowledge and information. This is a critical issue to address if AAS are to support successful responses to climate change.

The diverse environmental and social context in Africa has for some time suggested a need for localised agricultural innovation and climate change has reinforced this point, because of the uncertainties and incomplete knowledge inherent in climate change science. This requires the ability to: (a) identify and analyse challenges and opportunities, (b) access information and know-how, and (c) put the newly acquired knowledge to use. The ability of AAS individuals and organisations to contribute towards innovation is determined by their internal capacity and the wider AIS in which they operate. After years of underinvestment in African AAS, it should be no surprise that internal capacity is limited, but there are some signs that this is improving. However, further major investment is needed to strengthen AAS capacity in relation to agricultural innovation.

AAS organisations operating in Africa have experienced major change over the years, often driven by government or funding-agency decisions. Third-sector and private-sector organisations have often shown a greater ability to adapt to change than public-sector ones, which are notoriously 'sticky' institutions – but few organisations are fully 'adaptive' in responding to climate change and broader sustainability concerns.

In terms of access to and use of ICTs in adaptive AAS, the mobile-phone revolution is particularly salient for remote, rural communities. There is significant potential to harness the power of ICTs to improve access to climate change related information, for interactive communication, networking and shared learning. Engagement and investment from the private sector may also be forthcoming in this field, as seen with Vodaphone in Ghana.

Climate change and climate variability are starting to be addressed by the third and public sectors though various projects. It is much harder to assess the private sector, where information is much less readily available. However, **advisory methods** used by AAS may need to change in some quarters for an effective response to climate change. There has been a major move, particularly in the public and third sectors, towards more learning-based approaches to working with farmers – eg, farmer field schools – although practice on the ground does vary. If implemented appropriately (in a gender-sensitive manner, with good facilitation, etc.) and with commitment over time, these approaches can make an important contribution to strengthening adaptive capacity. More information is required on the advisory methods used by the private sector, and about the implications and outcomes of new partnerships that are often proposed between different types of AAS providers.

Using appropriate advisory methods with different rural people has tended to be a strong feature of the third sector, which often targets more vulnerable groups. New methods are being developed in gender-sensitive planning methods and efforts made to encourage gender-based action learning (eg, the Oxfam GALS approach). There is an opportunity to link this type

of gender-based action learning that looks ahead to future scenarios and supports women and men to identify desirable future pathways and outcomes to methods that inform local communities about climate change risks and helps them build scenarios (eg, the CRiSTAL tool).

Methods in agricultural development have tended towards working with farmers in various forms of collectives. However, how these methods are implemented makes a huge difference in terms of impact, sustainability of change in the longer term and building real capacity for self-organisation. Methods such as farmer field schools explicitly encourage experiential and shared learning and, as such, are likely to enhance adaptive capacity – there are examples where this is being applied to climate change adaptation.

Learning Alliances are important. Engaging diverse AIS actors in finding solutions is part of adaptive management, with a need for multi-directional communication in a sustainable mechanism to learn across scales about interactions between socio-economic and ecological processes.

Current climate change initiatives in AAS

Most initiatives on climate change adaptation are project-linked in line with recent policy agreements on poverty and climate change (eg, PRSP, NAPA-GEF) and donor/foundation funding modalities. Emphasis ranges from early warning of hazardous events, through trials of different practices to address water stress or excess, alternative varieties and crops, enhanced fodder production and soil fertility improvement, to testing harvest insurance schemes and access to new funds via carbon markets.

Although there are increasing numbers of completed adaptation projects, many activities are in planning or have only recently started. The wide range of investigatory climate change work in progress or that is about to begin would benefit from process monitoring and lesson learning, which AFAAS can facilitate.

6.3 Recommendations

This section provides key recommendations for AFAAS to support the shift towards more ‘adaptive’ AAS: first, in terms of influencing the wider AAS context; second, in relation to internal organisational actions; third, the steps to be taken by AAS (vision and governance, adaptive management, capacity strengthening and advisory methods); and fourth, the actions pertinent to programmes and projects.

6.3.1 Influencing the wider AAS context

1. Advocate to decision makers at appropriate levels to give space and provide incentives for AAS to respond to climate change issues.
2. Leverage funding opportunities that can contribute towards planning with a longer time horizon.
3. Support increased investment from governments, donors, private sector and NGOs in adaptive, climate-resilient agricultural development – in particular, AFAAS should advocate the NEPAD CAADP target of at least 10 percent of government expenditure allocated to agriculture *but* with a view to developing adaptive AAS.

4. Contribute to the debate on the balance between large-scale ‘silver bullet’ type approaches, and localised agricultural adaptation/innovation.
5. Encourage policies that support the identification of diverse potential agricultural development pathways and assessment of the most appropriate options.

6.3.2 At AFAAS Secretariat level

1. Revisit the AFAAS vision, mission and purpose in the light of climate change challenges and opportunities.
2. Create partnerships and linkages with other actors to improve AAS with respect to climate change.
3. Use networks to share lessons – particularly between AAS in agro-ecosystems that already face a specific challenge and others that are likely to face this same challenge in the future.

6.3.3 At AAS organisation and individual level

Vision and governance

1. Play a role in making different stakeholders’ visions and beliefs of agriculture, innovation and the role of different actors more explicit, and the implications of different options more widely understood, creating space for alternative narratives informed by climate change knowledge.
2. Facilitate a process of visioning among AAS stakeholders at all levels, exploring different agricultural development pathways that might exist in the light of a changing climate, taking into account equity, ecosystem services and productivity both now and in the future. Share the concepts of the ‘green economy’ and decoupling of natural-resource use and environmental impacts from economic growth.

Adaptive management

3. (a) Facilitate the sharing of adaptive-management concepts among AAS; and (b) support learning from experience in AAS about how best to move towards adaptive AAS management systems, approaches, incentives, etc., drawing on the principles outlined in this document.

Capacity strengthening

4. Facilitate sharing of information to improve understanding of climate science, including the associated uncertainties, and to manage AAS services and make decisions in a way that recognises and works with uncertainty.
5. Build capacity in M&E of adaptation and mitigation, drawing on emerging debates and experience.
6. Build capacity in gender-sensitive approaches to climate change adaptation and mitigation, including collection of disaggregated data along lines of gender and social difference in M&E and impact assessment.
7. Embrace new roles and gain new skills in facilitation, providing advice on probabilities and acting as an innovation broker – this includes influencing other AIS actors and processes to address climate change adaptation and mitigation.

8. Identify new sources of climate finance for AAS providers and other AIS stakeholders, and make them known among stakeholders.
9. Leverage and lobby for funds from public and private sources, including ICT companies, to improve access to, management and use of ICTs to support adaptive management, learning and information sharing to respond to climate change.
10. Facilitate sharing of: information on improving agricultural productivity while supporting other ecosystem services, understanding of ecosystem services in supporting livelihoods, and the opportunities and challenges of PES (payment for environmental services).
11. Facilitate sharing of information on: how market access is changed by climate change for different groups, different types of value chains and business models, which may increase income security and wellbeing, but may also increase vulnerability to market volatility; and new markets emerging in response to climate change, eg, biofuels, carbon markets, new labelling schemes, and their potential pros and cons.
12. Raise awareness of how climate change impacts may overlap with poverty and the methods available to reach the most vulnerable, eg, support for adaptive social protection measures (ie, measures to protect the poor or vulnerable that take into account longer-term risks posed by climate change), such as weather-index crop insurance, asset and cash transfer, seed fairs (Davies *et al.* 2009). Support evaluation of adaptation and mitigation measures from a pro-poor perspective, drawing on emerging good practice in climate change evaluation.
13. Target youth in AAS and wider agricultural context as they will be living longer with the impact of climate change and may start to influence decision makers.

Advisory methods

14. Promote and encourage the trend towards learning-based (rather than message-based) advisory methods, eg, farmer field schools.
15. Support mechanisms and platforms for ongoing climate information and knowledge management and learning at each institutional level/scale. Facilitate sharing of experiences and learning through sustainable mechanisms among public, private and third sectors and across scales – eg, learning alliance approach.

6.3.4 Programmes and projects

1. Identify and highlight features of AAS that are associated with well-run and effective climate change adaptive programmes and projects. Identify alternatives to project-based interventions.
2. Monitor and reveal the role of or need for adaptive AAS in contrasting kinds of projects, stimulating discussion on and support for organisations and policy makers working on climate change adaptation solutions.
3. Encourage projects to keep in view and in proportion the other drivers of change, which may be of equal or greater importance in changing local societies and environments.
4. Encourage those implementing climate change projects to build on existing institutions and mechanisms, where appropriate, to avoid duplication and fragmentation of effort.
5. Identify where changes are needed in the types of interventions undertaken by AAS and the organisational and policy changes needed to enable them to happen.

Appendix 1

Impact of climate change on cereal yields

In terms of impacts on crop yields, Nelson *et al.* (2009) have estimated the effects of climate change on the global yields of major crops between 2000 and 2050. They indicate the range of outcomes using different models and with and without CO₂ fertilisation effects (Table A1.1). Simelton *et al.* (2010) conclude that cereal harvests in countries undergoing economic and political transition are most vulnerable to droughts, and factors related to investments in the agriculture sector (eg, the amount of fertiliser used by farmers) helps reduce vulnerability. Nelson *et al.* (2010c) produced three overall scenarios under five climate scenarios in 15 perspectives on the future to 2050 that encompass a wide range of plausible outcomes – they conclude that:

- Broad-based economic development is central to improvements in human wellbeing, including sustainable food security and resilience to climate change;
- Climate change offsets some of the benefits of income growth;
- International trade plays an essential role in compensating for various climate change effects;
- Properly targeted agricultural productivity investments can mitigate the impacts of climate change and enhance sustainable food security.

Table A1.1: Climate change effects on crop production, no CO₂ fertilisation (percentage change from yield with 2000 climate to yield with 2050 climate)

Crop	Sub-Saharan Africa	Developing countries	Developed countries	World
Rice	-14.5 to -15.2	-11.9 to -3.6	-11.8 to -10.6	-11.9 to -13.5
Wheat	-33.5 to -35.8	-29.2 to -33.5	-7.6 to -11.2	-23.2 to -27.4
Maize	-9.6 to -7.1	-10.0 to -2.3	11.5 to -1.8	0.2 to -0.4
Millet	-6.9 to -7.6	-8.5 to -7.0	-3.0 to -5.6	-8.1 to -7.0
Sorghum	-2.3 to -3.0	-2.5 to -1.5	-3.1 to -7.3	-2.6 to -2.5

Source: Nelson *et al.* (2009).

Note: First figure is from the CSIRO model and the second figure from the NCAR model.

Appendix 2

Further ideas for moving towards more ‘adaptive’ agricultural advisory service (AAS) systems

Dimension	Indicators
<p>Assets</p> <p><i>Building up assets of farmers to respond to changing climate</i></p>	<p>How far do AAS help farmers and communities build up assets:</p> <ul style="list-style-type: none"> • Physical capital (eg, sand dams, flood defence schemes, boreholes) • Financial capital (eg, household savings, access to financial loans, livestock and household wealth) • Natural capital (eg, forest resources, access to water resources) • Human capital (eg, education, agricultural technologies) • Social capital (eg, social networks and organisation) • Political capital (eg, voice and influence in shaping AAS)
<p>Access to and control of assets</p> <p><i>Support for equitable institutions</i></p>	<p>How far does the AAS support farmer rights to resources and representation/ participation of farmers, especially the most vulnerable, in decision making in:</p> <ul style="list-style-type: none"> • Informal institutions (eg, whose animals and how many can use a water point) • Formal institutions (eg, farmer organisations, local government) and access to assets (income, land, seeds, social networks, etc.) <p><i>* Access to and control of assets and involvement in decision making is a key element in farmers’ ability to adopt adaptation technologies.</i></p>
<p>Knowledge & information</p>	<p>How far does the AAS have knowledge and information on the following:</p> <p><i>Climate change:</i></p> <ul style="list-style-type: none"> • Understanding of climate science and access to information • Access to downscaled projections for country (and locality) • Training on climate science <p><i>Climate impacts (over different time frames):</i></p> <ul style="list-style-type: none"> • Pre- and postharvest impacts • How different crops are affected • How pests and diseases are affected and their impact change • Indirect impacts (on food security, etc.) • What other rural stressors are important and will interact with climate change? • Who and where are the most vulnerable to climate change variability and longer-term climate change? • What are the underlying livelihood trends, shocks and stresses (frequency, nature, magnitude, etc.)? • What adaptation solutions do farmers use or propose? • Does the AAS adequately value and learn from farmer knowledge and practices? • How and why do farmers’ adaptation practices vary? • How informed are farmers of climate change challenges? • Does the AAS understand the potential limits to local knowledge over the longer term?

Dimension	Indicators
	<ul style="list-style-type: none"> • How do farmers receive climate information (eg, climate change science, weather forecasting)? (What roles are ICTs playing?) • Does the AAS promote (or at least not hinder) farmer adaptation? • Does the AAS actively encourage stewardship (ie, the responsible use [including conservation] of natural resources in a way that takes full and balanced account of the interests of society, future generations, and other species, as well as of private needs, and accepts significant answerability to society) with respect to how land is managed? • What is the range of options for addressing climate variability and longer-term change (<i>see under Innovation below</i>)? <p><i>Ways of working:</i></p> <ul style="list-style-type: none"> • How to respond to uncertainty of information and shift role to adviser on probabilities and trends • Participation of AAS in distribution of information (eg, flood early warning systems; meteorological data and forecasting; climate impact data) • How do users respond to disseminated information? How to build trust • How to listen to and learn from farmers about climatic changes experienced and potential adaptation solutions • What new partnerships are needed to deliver on agricultural adaptation (regional, local, national; what functions – delivery of services to farmers or training of extension workers, etc.)? • How well does the AAS learn about its own performance and evaluate its impact? Does it collect socially differentiated data on environmental and social impact? What approaches are favoured? How flexible and participatory are these (not just farmers, but also staff)? • What training do extension workers receive? How adaptive is the training provided (eg, focus on technologies only, or role as facilitator, adviser on probabilities, learning from farmers)? • How far do researchers and politicians listen to both farmers and extension workers (male and female)?
Innovation (knowledge into use)	<p>How does the AAS (and the wider AIS) enhance, support and/or drive:</p> <p><i>Farm-level innovation:</i></p> <ul style="list-style-type: none"> • Adapting whole farming systems to climate change – eg, conventional, conservation and organic agriculture • Adapting agricultural practices to climate change, such as: <ul style="list-style-type: none"> - Rainwater management - Irrigation management - Soil management - Seed management - Crop management - Agroforestry - Reforestation and avoided deforestation - Pest and disease management

Dimension	Indicators
	<ul style="list-style-type: none"> • Adapting livestock, pasture and rangeland management practices • Farm-level climate change mitigation practices • On- and off-farm diversification in livelihood practices • Diversification of species and varieties grown • Seasonal and permanent migration and remittances • Farmer organisation and social networking • Taking up new climate change finance, value-chain and learning opportunities <p><i>Policy and institutional-level innovation:</i></p> <ul style="list-style-type: none"> • Adaptation under the Rio Conventions and all relevant national policy frameworks (climate, DRR, social protection, sectoral, etc.) • Climate monitoring, provision of seasonal forecast information and early warning systems • Crop research and plant breeding (priorities that take into account climate change projections) • Agricultural advisory services • Rural radio services (provision of climate change information, plus agriculture adaptation and mitigation options) • Rural finance, agricultural finance and microfinance (to support climate-resilient agricultural innovation, ie, taking into account climate change information and adaptive strategies) • Value-chain partnerships (based on climate change knowledge and aimed at promoting farmer adaptation and mitigation for socially end environmentally responsible value chains) • Weather-indexed crop insurance • Paying farmers for ecosystem services (support farmer organisations to access new opportunities, while aware of risks involved and differentiated impacts) • Strategic grain reserves – potential means of encouraging more climate-compatible crops, eg, Tanzania Strategic Grain Reserve buying sorghum • Regulation and private trade standards (eg, encouraging uptake of new climate modules and criteria in private standards where farmer organisations are participating in certified value chains eg FairTrade) • Tackling discrimination and inequitable entitlements in the broader technology and rural development political economy <p><i>* What is the balance needed between planned, high-tech oriented, large-scale interventions; and autonomous, local-level initiatives that help innovate or adapt to changes in the local climate? Why do interventions (policies and projects) tend to concentrate on the former rather than the latter – diversified, locally developed solutions more likely to buffer against uncertainty and incomplete knowledge?</i></p> <p>How far does the AAS system support and reward staff for experimentation, protect against risks of failure?</p>
Self-organisation of farmers	<p>How far does the AAS support farmer organisation?</p> <ul style="list-style-type: none"> • Build strategies that use locally available resources • Support farmers to rely on and use their own resources (eg, advice, tools) • Promote cooperation and networking among farmers (including the most vulnerable)

Dimension	Indicators
	<ul style="list-style-type: none"> • Increase farmer knowledge of adaptation, including ability to respond to changing conditions, manage risk and to take up new opportunities (eg, use meteorological data in response farming, altering sequencing of farm activities) • Support for farmers to link to markets (but climate change informed decision making – eg, of future of crop or livelihood activity in changing climate, level of vulnerability to market fluctuations) <p>Support for contract negotiation (facilitation and informing role) – eg, of contract farmers and out-growers – that takes into account climate change</p>
Adaptive decision making and governance	<p>To what extent is AAS decision making informed by climate change issues? (<i>see also</i> Knowledge and information <i>above</i>; eg, what are the time frames, how far are climate change science and impact models used, vulnerability assessments, engagement with farmers?)</p> <ul style="list-style-type: none"> • What are the politics of AAS? Do they support flexibility and appropriate responses to climate change? • Who sets the agenda (donor influence, policy driven, political influence, experience/voice of farmers, extension workers, researchers, private enterprises)? • Transparency in decision making • Prioritisation (what are the dominant visions of agricultural futures guiding the AAS and are there unheard alternatives?) • How does the AAS respond to incomplete knowledge, uncertainty and multiple perspectives? Do adaptation options emphasise control, risk-oriented solutions or multiple, local, adaptive solutions? • What support is there to exploring scenarios and different possible pathways? • What options and barriers are there to adopting longer-term time frames? • In what ways and how much does the AAS narrow or widen power differentials among local communities with whom it works? • In what ways and how much does the AAS narrow or widen power differentials among AIS stakeholders (eg, private-sector influence, within the AAS itself)? • How far do AAS adaptation services tackle gender inequality and social discrimination? (How actively is this pursued?) • How strong is the linkage/what are the relationships among those involved in research, policy making, extension, organisational and human development? • What influence does AAS have in the shaping of the policy environment and research priority setting? • How far does the regulatory environment support flexibility? (eg, regulations that have requirements for the land owner/user to report on certain changing conditions) <p>How well does/can the AAS engage in communication and learning to support adaptation?</p> <ul style="list-style-type: none"> • Are there the necessary national dialogues and stakeholder platforms for learning from local level and for shared learning/enabling dialogue? • Are there necessary mechanisms and support for feedback on adaptation between stakeholders across scales? • Is communication supported between farmers on learning about adaptation? • Does the AAS value and support wider horizontal transmission of local ecological knowledge (of farmers and community members)?

Dimension	Indicators
	<ul style="list-style-type: none"> • What characterises communication between farmers and AAS practitioners on adaptation? (How is this influenced by AAS training, ideas on AAS approaches, structure of the AAS, incentives, guidance from policy makers and senior management?) • How far does communication embrace participatory approaches (eg, visual and aural communication methods, learning)? • How is communication between farmers and policy makers facilitated? (direct dialogue, via third parties, choice of media, value given to local voices) • What is the quality of the communication between farmers and researchers? • What kind of dialogue is there between public, private and civil society AAS agents regarding their approaches, targeting, activities, etc.? • How far are differences within households and communities taken into account in support for communication (eg, between farmers and researchers, between farmers and extension workers)?
	<p>Does the AAS have sufficient capacity to deliver ‘adaptive’ extension?</p> <ul style="list-style-type: none"> • As well as knowledge and information, does the AAS have sufficient staff to cover farmers? How well targeted is the support? How well coordinated are AAS stakeholders? • Training – approaches, etc. • Remuneration – amount and types of actions rewarded • Recognition <p>Do governance structures have the ability to adopt an integrated response (does climate change require restructuring)?</p> <p>How well does the public AAS link to other delivery partners/competitors:</p> <ul style="list-style-type: none"> • How far are AAS partners informed about climate change (eg, NGOs, private sector)? • How far does the AAS understand their motivations, activities and targeting – and <i>vice versa</i>? • What is the level of coordination on planning and implementation? Do activities conflict or support each other? <p>What impact does the AAS have? (<i>see Knowledge & information above</i> for questions on M&E)</p> <p>How efficient and cost-effective are the AAS adaptation services?</p> <p>Is there good understanding of the full range of costs, benefits, impacts of different adaptation options (eg, new livelihood strategies, new technologies, new financial mechanisms) and how appropriate they are for different social groups?</p>

Source: Based on ACCRA (nd), Ifejika Speranza, (2010.) and authors’ experiences.

Appendix 3

National agricultural polices – examples

In **Tanzania**, greater productivity, growth in the rural economy, and greater involvement of the private sector are all promoted, but it is not an export-oriented strategy (Binswanger-Mkhize and Gautam 2010). Overall, funds have risen from 4.6 percent of public expenditure in 2007/08 to 6.1 percent in 2009/10 (World Bank 2009), although this is significantly below the 10 percent of government expenditures agreed in the Maputo Declaration of CAADP. A targeted subsidy programme based on vouchers has been introduced, along with greater coordination of fertiliser imports and private-sector distribution of seeds and fertilisers. AAS are devolved to the districts, which are using a variety of agricultural extension models, and investment has increased in research expenditure, seed production and dissemination, irrigation and agricultural mechanisation. Kilimo Kwanza, or 'Agriculture First', has high-level governmental support in Tanzania. It has launched the Growth Corridors Initiative, a public-private initiative which aims to establish a 'critical mass of profitable, modern commercial farming and agri-business, focusing on carefully selected areas and crops with high market potential' (www.weforum.org/issues/agriculture-and-food-security). The clusters may involve larger-scale, nucleus commercial farms, smallholder out-grower schemes, serviced farm blocks, processing and storage facilities for smallholders and commercial farmers, and improved infrastructure to farms and local communities.

In **Senegal**, an agricultural law was passed in 2004 – the loi d'orientation agro-sylvo-pastorale, LOASP (Republic of Senegal 2004). Following a multi-stakeholder consultation process, it set out a policy framework for agriculture that aims to modernise the primary sector. It also emphasises a broader role for actors in agriculture – with increasing disengagement of the public sector from productive and commercial activities. The LOASP also sets out policy for de-concentration of sectoral staff, sustainable funding of demand-driven agricultural services, empowerment of producer organisations, and competitive funding of research activities. The Public-Private National Agricultural and Rural Advisory Agency (ANCAR 2011) has been created to provide a more demand-based approach in partnership with farmer organisations, NGOs, projects, rural development programmes, etc.

In **Mozambique**, the Agricultural Development Strategy seeks to support growth in rural agriculture, enhancing: (a) the productivity of subsistence smallholders producing food grains and products for the domestic market through provision of improved seeds and other inputs for the food-crop sector and more demand-driven research and extension services; (b) the bargaining power of smallholders in out-grower schemes, through improved cash-cropping expertise and mechanisms, to reach a more level playing field, and avoid side-selling. Investment in cashew, horticulture and livestock is proposed (World Bank 2006a).

The **Malawian** government has implemented a well-known programme of farm-input subsidies, which moved the country from significant food insecurity to national food security. *'The fertiliser subsidy is currently the dominant policy initiative in the agriculture sector in Malawi. Successive bumper harvests are attributed, at least by government officials, to the subsidy policy and this has given particular prominence to agriculture in national policy and politics, and has helped to revitalise the idea of a strong role for the state in granting access to input, credit and markets to farmers'* (Chinsinga and Cabral (2010).

In **Benin** in 2006/07, the Ministry of Agriculture launched the 'Strategic Plan for Agricultural Revival' (PSR-SA) to provide a comprehensive framework for the implementation of agricultural investments. PSR-SA's overall objective is to improve agricultural performance to enable its effective contribution to economic growth, food security and achievement of the Millennium Development Goals (MDGs). Four specific objectives are defined: (i) improving governance and leadership within the agricultural sector; (ii) increasing agricultural productivity and competitiveness; (iii) ensuring nutrition and food security; and (iv) ensuring sustainable management of lands, pastures and fisheries (Houngbedji 2009). In 2007, responding to the threat of a food crisis, Benin was among the first West African countries to propose an Emergency Plan for food security support (PUASA), and several other agricultural subsidies and tax exemptions. The PUASA focused primarily on rice and maize, through: free distribution of improved seed; organising the supply of subsidised fertilisers (credit or cash); rehabilitation of abandoned irrigation schemes; and installation of shops in major and minor towns. More generally, between 2007 and 2009, Benin doubled its budget for the agricultural sector, which now represents 12 percent of the national budget, more than fulfilling its commitments under NEPAD/CAADP. There are two competing visions of agricultural development in Benin. The first calls for massive public support for industrial agriculture, the second in support of family farming. The government is trying to reconcile the two approaches, but with a leaning towards more support for family farms. The PDAVV (Program diversification of agriculture by promoting valley farming, 2008) has benefited 76,000 smallholder farmers. However, the measures taken under the PUASA and on mechanisation policies have primarily benefited large farms.

Appendix 4

Decentralisation examples in SSA

Country	Nature and extent of decentralisation
Benin	The Agricultural Development Programme of the Rural Areas/Communes (PDAC) aims to promote, within the context of decentralisation, agriculture in the 77 communes of Benin. The project 'Strengthening the Capacity to Adapt to Climate Change in Rural Benin' (PARBCC), established in late 2007, aims to create a three-way conversation among farmers, meteorologists and the government, and help farmers make informed choices about when to sow and harvest crops. Using farmer field schools to engage communities and facilitators, a network of early warning committees had been established by PARBCC in 35 of Benin's 77 rural municipalities by 2008 (Chabi 2009; IDID-ONG 2009).
Ghana	Ghana is reviewing its decentralisation policy for the first time in 20 years, which is likely to lead to local governments gaining greater administrative, financial and political authority, but the extent of the decentralisation is likely to be small, with capability and accountability of local government still weak. Wide-ranging decentralisation that would improve local government significantly, requires the central government to solve difficult challenges surrounding administration and finance at the local level, national unity, and the inclusion of traditional authorities in local government (Hoffman and Metzroth 2010).
Nigeria	A high degree of autonomy at state- and local-government levels has been achieved, with fiscal decentralisation to all 36 states and 774 local governments, enabling them to have 'considerable policy autonomy, control of 50% of government revenues and responsibility for the delivery of public services', but governance in most states is weak (World Bank 2011).
Senegal	Senegal established local authorities (councils) with decision-making powers in 1996, but local councils have had only limited ability to advocate for local resource use for local communities in the face of pressure from other coalitions in practice (Ribot 2009).
Ethiopia	Agricultural research and extension are within the mandates of the regional governments. EARO, the old central research organisation, has been stripped of most of its powers and almost all its stations. There does not seem to be a national extension policy. Human capital, and general government capacity and delivery, in research and extension vary greatly between the regions, being highest in Amhara and Tigray (J. Morton, NRI, personal communication).
Kenya	The championing of 'majimbo' by Prime Minister Raila Odinga suggests that the policy could one day have sufficient local ownership to be implemented fairly wholeheartedly. This could be good news for the budgeting for, and delivery of, agricultural and rural development services to smallholder producers around the country (Anon 2009).
Tanzania	Tanzania has come a long way since it first undertook decentralisation reform in 1972. It has moved from a centrally planned, one-party socialist system towards a multi-party democratic state with an open economy. But the process has been painstakingly slow and, for true devolution to occur, a lot more needs to take place. Tanzania seems to have a de-concentrated local government system with central appointees having great power at the local level. Centrally funded mandates dominate local government plans and budgets. Central control over administrative functions has ensured that administrative decentralisation is yet to occur. In the fiscal sphere, progress has been made in

Country	Nature and extent of decentralisation
	transparency and harmonisation of transfers in the 5 years up to 2009/10, but local governments still have some way to go in raising their own revenues, being less reliant on transfers, and ensuring downward accountability (Venugopal and Vilmaz 2010).
Uganda	A large number of new districts have been created in recent years, creating major challenges to provide resources – including AAS – at district level.
Malawi	Decentralisation has been promoted by donors (eg, UNDP, Norad and GTZ/GIZ) since the early 1990s, but has stalled on several occasions, and suffered a major reversal with policy changes (amendments to the Local Government Act) in early 2010 (Anon. 2009). The commitment of the national political elite to decentralisation is questioned by Anon. (2009). Local-government elections have twice suffered long delays due to fears of the political elite that they had insufficient support outside of their regional heartlands (Anon. 2009).
Mozambique	Decentralisation and organisation of rural producers are both key institutional challenges (World Bank 2006a), with capacity and fiscal decentralisation being weak. ¹ Although recent decentralisation has had some capacity-building success (eg, for public works capability), there have been no funds allocated to district levels.

Appendix 5

Country National Adaptation Programmes of Action (NAPAs) posted

Benin <http://unfccc.int/resource/docs/napa/ben01f.pdf> (French) January 2008

Burkina Faso <http://unfccc.int/resource/docs/napa/bfa01f.pdf> (French) December 2007

Burundi (French / English) February 2007

Cape Verde <http://unfccc.int/resource/docs/napa/cpv01.pdf> (English) December 2007

Central African Republic <http://unfccc.int/resource/docs/napa/caf01f.pdf> (French) June 2008

Chad (French) February 2010

Comoros (French / English) November 2006

Democratic Republic of Congo <http://unfccc.int/resource/docs/napa/cod01.pdf> (French) September 2006

Djibouti <http://unfccc.int/resource/docs/napa/dji01f.pdf> (French) October 2006

Eritrea <http://unfccc.int/resource/docs/napa/eri01.pdf> (English) May 2007

Ethiopia <http://unfccc.int/resource/docs/napa/eth01.pdf> (English) June 2008

Gambia <http://unfccc.int/resource/docs/napa/gmb01.pdf> (English) January 2008

Guinea <http://unfccc.int/resource/docs/napa/gin01f.pdf> (French) July 2007

Guinea-Bissau <http://unfccc.int/resource/docs/napa/gnb01.pdf> (English) February 2008

Lesotho <http://unfccc.int/resource/docs/napa/lso01.pdf> (English) June 2007

Liberia <http://unfccc.int/resource/docs/napa/lbr01.pdf> (English) July 2007

Madagascar <http://unfccc.int/resource/docs/napa/mdg01f.pdf> (French) December 2006

Malawi <http://unfccc.int/resource/docs/napa/mwi01.pdf> (English) March 2006

Mali <http://unfccc.int/resource/docs/napa/mli01f.pdf> (French) December 2007

Mauritania (French / English) November 2004

Mozambique <http://unfccc.int/resource/docs/napa/moz01.pdf> (English) July 2008

Niger <http://unfccc.int/resource/docs/napa/ner01f.pdf> (French) , <http://unfccc.int/resource/docs/napa/ner01e.pdf> (English) July 2006

Rwanda <http://unfccc.int/resource/docs/napa/rwa01f.pdf> (French), <http://unfccc.int/resource/docs/napa/rwa01e.pdf> (English) May 2007

São Tomé and Príncipe <http://unfccc.int/resource/docs/napa/stp01.pdf> (English) November 2007

Senegal <http://unfccc.int/resource/docs/napa/sen01f.pdf> (French) November 2006

Sierra Leone <http://unfccc.int/resource/docs/napa/sle01.pdf> (English) June 2008

Tanzania <http://unfccc.int/resource/docs/napa/tza01.pdf> (English) September 2007

Togo <http://unfccc.int/resource/docs/napa/tgo01f.pdf> (French) September 2009

Uganda <http://unfccc.int/resource/docs/napa/uga01.pdf> (English) December 2007

Zambia <http://unfccc.int/resource/docs/napa/zmb01.pdf> (English) October 2007

Source: UNFCCC.

Appendix 6

Examples of NGO-inspired climate change initiatives

The **Climate Action Network** (CAN) is a worldwide network of over 550 NGOs working to promote government and individual action to limit human-induced climate change to ecologically sustainable levels (www.climatenetwork.org/about/about-can). ENDA-TM is a key player in the CAN West Africa regional network.

The **Stop Climate Chaos Coalition** is dedicated to action on climate change and limiting its impact on the world's poorest communities. Its combined supporter base of more than 11 million people spans over 100 organisations, from environment and development charities to unions, faith, community and women's groups. The Coalition's steering group consists of Friends of the Earth, Oxfam, Greenpeace, WWF-UK, Christian Aid, Tearfund, CAFOD, World Development Movement, UK Youth Climate Coalition and Royal Society for the Protection of Birds (RSPB).

The **Up in Smoke** coalition is a unique and diverse network of development and environment organisations collaborating in one working group. Its central message is that solving poverty and tackling climate change are intimately linked and equally vital, not either/ors. www.upinsmokecoalition.org.

Innovation Environnement Développement (IED) Afrique coordinates Climate Change Adaptation for Africa (CCAA)-sourced funds for climate change adaptation – Mali, Senegal, Niger, Burkina Faso.

Initiatives for Sustainable Integrated Development (IDID), founded 2006 to support local communities in development generally, particularly in preserving the environment and rational management of natural resources and adaptation to climate change. <http://ididong.org/a-propos-2/>.

Pan African Climate Justice Alliance (PACJA) aims to influence UNFCCC Conference of the Parties (COP) meeting negotiations, including pushing African government negotiators to be more vocal.

Appendix 7

Examples of climate-specific AAS interventions

A7.1 Availability of, access to and use of climate knowledge

Tanzania and Malawi – a CCAA (Climate Change Adaptation for Africa) project which is aiming to strengthen the capacity of local AIS to respond to climate change. This is a collaboration between the Institute of Resource Assessment (University of Dar es Salaam), Chancellor College (University of Malawi) and Natural Resources Institute (University of Greenwich, UK) and other partners, funded by the International Development Research Centre (IDRC) and DFID. It is linking meteorological office staff, farmers, district agricultural extension staff, NGOs, researchers and the media. The meteorological office has provided various weather and climate information to other stakeholders within villages and via workshops. Farmer learning groups are now systematically collecting rainfall and temperature data within their localities. A key element of the project is to learn how information that is made available is currently and potentially used to strengthen adaptive capacity.

Rural Benin – a third-sector NGO project ‘Strengthening the Capacity to Adapt to Climate change’. This project is improving access to information about climate change science, climate information and discussion about climate change impacts, including the areas and sectors most vulnerable to climate change, as well as adaptation strategies suited to local conditions. Key achievements to date include the establishment of a national committee for agro-meteorological interpretation, comprising experts and beneficiaries, which translates meteorological data into useable forecasts for farmers – information which is then communicated through village networks and rural radio broadcasts together with advisory information that helps farmers and other households prepare for the coming season. Pre-alert or early warning committees had been established in 35 of Benin’s 77 rural communes by 2009, serving a population of close to 3.5 million. Some 300 farmers in 60 farmer field schools are testing a range of options that will help farmers deal with uncertainty. The project has demonstrated the need for farmers to adjust their agricultural calendar and switch to agricultural practices that make better use of rainwater, runoff and wells (*Joto Afrika* 2009).

A7.2 Adaptation to climate change

Addressing vulnerability

Strengthening institutions to provide voice to vulnerable people to influence adaptation planning and implementation. The development of NGO interest in climate change adaptation has come with the introduction of new institutional frameworks that have added responsibilities, and perhaps further confusion, at local community level in Malawi. These include ‘democratically elected’ sectoral committees and NGO-based committees, which have often ignored existing informal institutions and traditional leadership. The multiplicity of committees challenges the effective implementation of community-based adaptation programmes and projects. A project led by the Centre for Environmental Policy and Advocacy (CEPA) considers how to harmonise existing informal institutions and traditional leadership; introduce institutional arrangements for community-based adaptation; and how to make them accountable local communities.

Capacity Strengthening in the Least Developed Countries on Adaptation to Climate Change (CLACC). A programme initiated by the International Institute for Environment and Development (IIED) – see www.iied.org.uk.

Child-centred adaptation and disaster risk reduction: lessons from Mozambique (Save the Children). The impact of climate change on children is already being felt and the poorest children are bearing the brunt. Water scarcity, reduced agricultural yields, and the increased frequency of disasters all hit children the hardest. Children also have many more years than adults in which they must face the impacts of climate change. In Mozambique, the Junior Farmer Life School educates children on alternative agricultural practices and climate change; as well as innovative disaster risk reduction activities such as child parliaments in which children can express their views to decision makers. The project provides a strong model for combining climate change with education on the impacts of environmental degradation.

Natural-resources management

The Agricultural Services Support Programme and the Agricultural Sector Development Programme – Livestock (ASSP/ASDP-L) Zanzibar, Tanzania. Adaptation to climate change requires strategies by farmers and government. This project was implemented in nine districts in Zanzibar aiming to deliver sustainable natural-resource management and adaptation at the community level. The programmes were based on empowerment: improved skills and technologies through a farmer field school approach. Focusing on the communities, the programme sought to improve crop and livestock diversification; the use of organic fertilisers, soil and water conservation; disease and pest control; and irrigation. The participatory action-research conducted by farmer field schools specialised on cassava, and farmers selected high-yielding, heat-tolerant and early maturing varieties Mwari and Sepideh, which are now considered to be the most successful cassava varieties.

UNDP and the Senegalese government are in the process of developing a project ‘Supporting Integrated and Comprehensive Approaches to Climate Change Adaptation in Africa’ (www.cakex.org/virtual-library/1099). Agricultural intensification in Senegal has led to innovation using seeds, fertilisers, ploughed furrows, and drip irrigation. Crop diversification is used to rejuvenate the soil, after years of growing only groundnuts has depleted the soil of nutrients. Windbreaks have also been implemented to protect the crops from wind, restrict evapotranspiration of moisture into the atmosphere, and provide organic support that is beneficial to soil fertility. In addition, packaging systems have been enhanced and have been implemented locally, thereby providing more employment opportunities for the local population. Another option being explored in Senegal is sequestration, which will help the country comply with the Kyoto Protocol and will bring in added revenue, in addition to the agricultural industry. http://sitemaker.umich.edu/aid_climate_change/26._agriculture_intensification_in_senegal.

Environment and Development Action in the Third World (ENDA-TM) is addressing food insecurity in Maradi, Niger, building a sustainable partnership and working closely with local communities in a participatory manner. In Maradi district, most people practise rainfed agriculture. However, rainfall has become more uncertain, seasons have become shorter and annual temperatures more extreme, resulting in food production decreasing every year.

Coping mechanisms include the sale of animals and crafts; purchase of food, particularly from inter-community or state cereal banks; temporary migration to neighbouring countries; or permanent migration over longer distances. The study found that the root cause of migration is the unreliable conditions of local livelihoods. Owing to permanent climatic changes, people tend to move and settle permanently in countries like Nigeria, Côte d'Ivoire or Libya. Those who migrate to Libya tend to reach European countries, legally or otherwise. Overall, the study demonstrated that adaptation to climate change should no longer be considered only as a local issue, but as a multilevel, multi-scale process. For example, the construction of a dam at Jibya, upstream on the Goulbi River which flows from Nigeria to Maradi district in Niger, means that irrigation using the Goulbi River in Maradi requires cooperation between decision makers in both Niger and Nigeria.

Management of water resources

Climate change vulnerability assessments for water-focused projects were conducted under the Global Water Initiative (GWI) in Ethiopia, Uganda, Kenya and Tanzania by IUCN and CARE International. They used the Climate Vulnerability and Capacity Analysis (CVCA) tool and CRiSTAL (Community-based Risk Screening Tool – Adaptation and Livelihoods). The aim was to operationalise activities that are outlined in the NAPAs and identified in detail through these vulnerability assessments.

Africare projects in Zimbabwe supporting farmers to cope with drought. Zimbabwe has been experiencing recurrent droughts and dry spells. Africare works with communities on technologies that enhance farmers' capacities to cope. Technologies used include water-harvesting techniques, such as small water-holding ponds, infiltration pits and dead-level contours. Working with farmers in Zvishavane district, dry land has been transformed into crop-sustaining land. Farmers transformed semi-arid arable land into a microenvironment that supports the production of fruit trees, a wide range of annual crops, vegetables, reeds, swampy-area crops (yams), and fish and bird life.

Indigo Development & Change project supporting smallholder farmers in Suid Bokkeveld, South Africa to cope with water scarcity. In South Africa, small-scale farmers in Suid Bokkeveld are farming in harsh environments in which people's livelihoods depend upon livestock, rooibos tea and subsistence farming. With support from Indigo Development & Change, the farmers established a monitoring system to record the levels of water in boreholes and the water quality of fountains. The project aims to set up an early warning system that will inform the farmers of dropping borehole levels, allowing them to develop and implement appropriate strategies.

Malawi Ministry of Irrigation and Water Development projects to improve local-level water management. Malawi is already experiencing climate change and climate variability in the form of frequent floods and droughts. The Ministry of Irrigation and Water Development's strategies include: borehole drilling, especially deeper boreholes to withstand the effects of climate change in drought-prone areas; gravity-fed water supply schemes, some of which are designed with large built-in water storage facilities; construction of small, medium-size and large dams; flood forecasting and warning systems.

Community-based adaption methodologies.

Ghana: CARE conducted a review using their ‘Toolkit for Integrating Adaptation into Projects’ as part of their existing Local Extension Services for Agricultural Development (LEAD) Project (www.careclimatechange.org/files/toolkit/CARE_LEAD_Project.pdf). Recommendations resulting from the process of applying the Toolkit on the LEAD project included: (a) improve analysis of the current and future climate context and linkages between climate and livelihoods; (b) strengthen analysis of vulnerability, including participatory approaches; and (c) promote climate-resilient agricultural strategies. The review noted that there was no discussion in the project design analysis sections of specific crops or technologies being used by target populations or of how appropriate these were to current and projected climate conditions. Further, there was no information on how people make decisions about livelihoods strategies. These gaps made it difficult to identify the needs and priorities that must be addressed by an appropriate and sustainable community-based extension system (CBES), especially if it is to address climate change as suggested in the project document. Key issues identified in selecting agricultural strategies to be promoted through the CBES were the appropriateness of the crop and livestock types and the sustainability of agricultural practices in the context of current and future climate change, with particular emphasis on the impacts of droughts, floods and changing rainfall patterns. With regard to disaster risk reduction (DRR) and emergency preparedness, the review notes that the success of the integration of DRR into the project will depend on how effectively the CBES model and community action plans incorporate: household-level risk reduction strategies (including protection of assets such as livestock, and saving reserves of food, water and agricultural inputs); disaster risk management planning (including early warning systems, at community and district levels); capacity development for emergency response by local stakeholders; and linking local stakeholders and strategies to national disaster risk management efforts. In terms of emergency preparedness at the project level, the following issues should be considered: an emergency preparedness plan for the sub-office that staff and partners are familiar with; training of staff and partners in emergency response and humanitarian accountability; ensuring the project team has access to early warnings of hazards affecting the project area; incorporating a contingency plan for emergencies in the project strategy; ensuring flexibility in funds and activities to respond to crises efficiently.

IUCN undertook a climate change vulnerability assessment in four villages of lower Rufiji, Tanzania using CRISTAL. Lower Rufiji is exposed to the impacts of climate change: mainly floods, droughts and strong winds. Livelihood activities – eg, farming, fishing and beekeeping – and livelihood resources, especially natural resources, are severely impacted by these hazards. During the assessment, community representatives identified some coping strategies that are used to address climate change hazards. These included gathering and eating wild fruits and roots, water rationing, supplementary feed to bees, temporary settlements, use of traditional medicine, and income diversification. However, most of these strategies had limited success or were not sustainable in the face of long-term climate change impacts. This demonstrated a need to develop adaptation activities that are both functional and sustainable. Revised coping strategies that translated into adaptation measures included: promoting conservation farming;

construction of permanent water sources; improving hygiene and sanitation; planting of trees around/along water sources, farms and settlements; establishing an irrigation system; and entrepreneurial training. The assessment (Reid *et al.* 2010) highlights the substantial time and resources needed for implementing the adaptation measures.

Participatory video M&E work in Kenya and Zimbabwe through the community-based adaptation programme (InsightShare). Now that video tools are easily accessible and affordable, organisations have been able to cheaply, quickly and effectively communicate lessons from the field to help share adaptation strategies. Community-based adaptation videos aim to spread these adaptation stories across communities, organisations and nations. The template ensures that the necessary information is told within each film, and that their production remains accessible to most organisations. It is not easy to gauge and communicate the effect that a programme has had on the lives of beneficiaries. Those best positioned to explore and convey these messages are the beneficiaries themselves – they are trusted sources and can speak about firsthand impacts and outcomes. For this reason, participatory video adds value, encourages iterative learning, and explores qualitative data often missed through traditional M&E methods.

Community adaptation within disaster risk reduction

Oxfam’s Emergency response and DRR project aims to strengthen its support for humanitarian preparedness and response in Nigeria through promoting stronger coordination of efforts of all humanitarian actors at national, state and local levels. Working with local partners, Oxfam will maintain an up-to-date Humanitarian Contingency Plan developed through stakeholder reviews and annual reflection meetings. Oxfam also seeks to build the capacity of partners and allies to improve programme resilience to emergency situations and monitor potential problems related to food and income security, natural disasters and conflicts.

The Strengthening Climate Resilience (SCR) project, in partnership with the African Climate Change Resilience Alliance (ACCRA), seeks to increase resilience to climate change among vulnerable people by enhancing the ability of governments and civil society organisations to manage disaster risk and uncertainties more effectively. The two consortia (SCR and ACCRA) are working together to develop a framework which will allow them to assess and collect evidence of where disaster risk management interventions contribute to climate resilience, before going on to use this evidence to advocate for changes in practice and policy. In this context, the framework will identify characteristics and indicators of climate-smart disaster risk management, while bearing in mind the following question: what do disaster-risk managers, linked practitioners and policy makers working across all development sectors need to do differently in the light of the impacts of climate change? Both consortia are working in East Africa through a number of partner agencies. Both the SCR and ACCRA will be conducting field research, holding consultations and knowledge-sharing events to identify an evidence-base of policies, projects and programmes that highlight the benefits and trade-offs involved with integrating climate change adaptation, disaster risk management and other development approaches.

Community-based adaptation for drylands and pastoralism

Enhancing Adaptive Capacity of Pastoralists to Climate Change in Northern Kenya was a 2-year project implemented by Practical Action. The research showed three main strategies

for household survival: physical, capital and pastoral strategies. These ranged from herd accumulation, animal diversity and a more varied diet; to herd mobility beyond the normal dry-season grazing areas, herd dispersal, selective breeding, intensification of land for animal feed, and conquering 'enemy' grazing land or acquiring permission to use it. The project identified four policies where action and resources are needed. First, peaceful coexistence and security among local communities in northern Kenya must be strengthened for effective adaptation of pastoralists through improved access to pasture and water. Second, mobility must be ensured for livestock herds, because access to pasture and water is the best adaptation strategy for pastoralists. This must be recognised and supported by the government agencies responsible for protecting pastoralists' land and resource rights. Third, increased access to additional adaptive skills in planning and managing rangeland resources is needed, as well as access to sources of information such as seasonal forecasts and market intelligence. Finally, the removal of constraints to efficient livestock markets: improved market infrastructure, vet services, flood-proof roads, and communication links.

Community-based adaptation in urban areas

The Universities of Dar es Salaam and Malawi are working with AAS organisations in Tanzania and Malawi exploring urban–rural social and environmental interdependence and impacts of climate change (www.ccaa-urban.or.tz/index-1.html). This action-research project is exploring the linkages between rural localities and centralised urban centres. The focal system is the linked urban–rural agriculture and food systems aiming to explore resilience and strengthen the capacity of actors in these innovation systems to respond to climate change and climate variability.

Communication and scaling up

Managing and communicating knowledge about good community-based adaptation.

Oxfam GB has been working in collaboration with weADAPT since mid-2009 to design a suitable online knowledge base and web platform for learning. This platform is aimed at promoting learning and sharing on climate adaptation among Oxfam practitioners and others. The overall aim of the collaboration is to create and sustain a global online learning and sharing resource for Oxfam GB programme practitioners working on climate change adaptation. During the development of weADAPT, many lessons were learned, including the need for more 'translation', less technical language, and the need for more context-specific examples of adaptation. Oxfam observed a mismatch between the information that practitioners want, and the answers that science can provide (eg, detailed information on impacts). There also exists a preference for audio-visual media, as well as a need to navigate and find content more easily. Lastly, there is the greater need to move beyond information sharing to knowledge co-production.

AfricaAdapt is an independent bilingual network (French/English) focused exclusively on 'Africa'. The Network's aim is to facilitate the flow of climate change adaptation knowledge for sustainable livelihoods among researchers, policy makers, civil society organisations and communities who are vulnerable to climate variability and change across the continent. The network uses an interactive web-based information portal, as well as other media such as

community radio, mobile phones, print publications and face-to-face meetings, to share knowledge, know-how and any information to support climate change adaptation in Africa for the benefit of vulnerable communities.

New climate change programmes produced by the Malawi Development Broadcasting Unit (DBU). The DBU was established in September 1999 as an autonomous not-for-profit, public-sector unit under the Malawi Broadcasting Corporation (MBC). Success stories using this Radio for Development approach in Malawi are well documented. Facilities such as health centres, clinics and water points have been provided in remote parts of the country. Climate change is a new topic that the DBU has taken on board, and several projects are in the formulation stages to be rolled out in 2011.

Vodafone Ghana, in collaboration with the Environmental Protection Agency (EPA), has launched a project called 'Integrating Climate Change into Telecommunication Industry'. This project is aimed at supporting and contributing to environmental issues, especially in combating climate change. The project will see the integration of climate change into telecommunications in Ghana as part of a wider strategy to establish an early warning system for disaster prevention and recovery in Ghana. www.theghanaijournal.com/2010/07/27/climate-change-project-launched.

Farm Radio Programme Climate Change Adaptation Goes Soap: Using radio drama to share ways smallholder farmers in Nigeria can adapt to a changing climate. NGOs are hardly involved in direct farm broadcasts except to sponsor those of the ADPs to advertise their business concerns. This case study examines the potential of a radio-drama project to enhance learning and dialogue in farming communities coping with climate change in northern Nigeria. It illustrates the following principles of resilience: promoting opportunities for learning at household, local and regional levels; and supporting flexible and adaptive approaches to learning that engage multiple actors. www.farmradio.org/english/donors/news/Nigeria.pdf.

Scaling up and replicating best practice

Addressing climate change throughout the programme cycle, Oxfam. Oxfam's approach to climate change adaptation focuses on the core areas of DRR, livelihoods and natural-resource management, while ensuring that gender is addressed as a cross-cutting theme. It is an approach that includes working at multiple levels, from community and local, to national and international. The approach further advocates for a range of interventions that deal specifically with climate change impacts, as well as addressing the underlying vulnerability to climate risk. In addition, Oxfam is addressing climate change through its programme management cycle: from identification and analysis; through programme planning and design, implementation and management; to monitoring, evaluation and learning.

The Relief Society of Tigray (REST), in collaboration with local community institutions and governments, promotes various water-harvesting technologies to address water availability for agriculture and households as critical enabling factors for adaptation. The activities focus on scaling up small-scale, labour-intensive water-harvesting technologies; organising communities on a watershed basis and undertaking participatory planning; and community mobilisation for public work in collaboration with local *Baito* (local government structures). The presence of strong institutional collaboration and community governance was critical to

the successful scaling up of these crucial adaptation measures. Thus far, about 1.4 million ha (50 percent) of the regional land mass have been covered with soil and water conservation (SWC) measures. There has been an increase in access to dry-season irrigation from 4000 ha in 2005 to 70,000 ha, with plans to expand to 300,000 ha by 2012. Furthermore, irrigation is now practised at the household, group and community levels. Many key lessons have been learned from the project. First, the fact that communities are already coping demonstrates their capacity to adapt to climate change using their own initiatives. There is a great need to integrate good adaptation practices into existing development planning at community, regional and national levels, in collaboration with government institutions in order to achieve faster up-scaling. Civil society organisations are capable of piloting various types of local adaptation technologies, but scaling up is a major role of the government, because of its accountability to its citizens. Lastly, it is essential for their success that adaptation strategies confront structural constraints to adaptation, such as policies for water user rights, both at community and regional levels (conflict prevention).

Practical Action's 'Greening Darfur' programme is aiming to build adaptive livelihoods.

Practical Action has continued to implement development work in north Darfur, Sudan throughout the conflict period, focusing on increasing food security through better soil and water management. A key aspect of the work has been building the capacity of community-based organisations, and then forming networks among them. Building on this work, a new programme called 'Greening Darfur' began in 2010. The intended outcome of Greening Darfur is adaptive livelihoods. This will be achieved by bringing together the following elements: civil society networks (networks of Village Development Committees and Women's Development Associations) achieving effective linkages between their members and government institutions; systematic gathering of relevant information on land, water, agriculture, livestock and climate; communication and awareness of this information for all stakeholders conducting participatory action planning; presentation of Participatory Action Plans as projects to draw down financial resources – including international adaptation funds; implementation of the Action Plans, for example, the construction of a water-harvesting dam; and replication of this planning process at all levels from villages up to territories.

Cross-cutting

Strengthening adaptive capacity.

In Benin, the project 'Strengthening the Capacity to Adapt to Climate Change in Rural Benin' is being implemented by the NGO IDID. This project, which is being implemented by an NGO–research institute partnership under IDID, has strengthened capacity of service providers to package agro-meteorological information in a form that farmers can use, and has engaged producers in co-learning and adaption of farming practice to adjust faster to climate change and variability. The options, tested in some 60 farmer field schools and derived from surveys of local coping practices as well as external knowledge, includes soil and water management practices (such as alley cropping and mulching), integrated crop management (such as late/staggered planting together with less-drought-tolerant crops), alternative crops and crop mixtures (eg, maize–mucuna, soya bean, pigeon pea), mulching and manure/mineral fertiliser application (IDID-ONG 2009). The most promising options are being taken into further rounds of farmer field schools testing and adaption. The Government of Benin has recognised the

project as contributing to the country's NAPA. The research team has been invited to play an important role in facilitating community input into Benin's National Water Partnership, which supports irrigation and other water-management initiatives (Hounkponou and O'Neill 2009).

The Ogaden Welfare and Development Association (OWDA) work supports the adaptive capacity of pastoralists to enable them to withstand the natural and man-made shocks affecting their lives. The Adadle Community Development Project subsequently improved the technical skills and involvement capacity of Woreda and Kabale Pastoral Development Committees. This work has sought to mainstream adaptive capacity through inclusive and participatory approaches, bringing together the grassroots pastoral community, Kabale and district authorities in order to co-plan and take responsibility for their local development initiatives. The technical skills of the local administration in planning and implementation capacity have been further enhanced. The provision of a community development fund for the action plans developed by the committees was created; and wider linkages and networks were established.

The Government of Niger's National Environment Council for Sustainable Development (SE/CNEDD), in the Office of the Prime Minister is to implement the Pilot Program for Climate Resilience (PPCR). The key objectives are:

- Testing the effectiveness of the adaptation options (strongly agriculture/livestock oriented) proposed in the context of NAPA and many other activities proposed in strategies and sectoral action plans related to climate change;
- Capitalising on experiences and good practices related to the incorporation of risk and adaptation to climate change into national planning;
- Completing the process of identifying real capacity-strengthening needs (technical, human and institutional), as well as technological needs over the long term;
- Mobilising all future financing for purposes of adaptation and spearheading adaptation activities based on a global and programmatic approach.

PPCR is part of the Strategic Climate Fund (SCF), a multi-donor Trust Fund within the Climate Investment Funds (CIFs). The overall objective of the programme is to provide incentives for scaled-up action and transformational change in integrating consideration of climate resilience into national development planning consistent with poverty reduction and sustainable development goals.

Insurance and microfinance

Malawi: Weather-based crop insurance programme support by FAO through a World Bank project. Farmers in Malawi are being given the option of buying insurance based on weather events rather than on crop losses. Technically supported by FAO through a World Bank project, the scheme sells insurance in standard units, eg, US\$ 10 or \$100, and insurers pay out for extreme weather events, eg, if rainfall is 20–30 percent below normal. With this approach, all participants receive the same payout per unit of insurance. In addition, the Government of Malawi is protected from risk because it is reinsured on the global weather insurance market (FAO nd-b).

The World Bank, in close collaboration with Malawi's National Association of Small Farmers (NASFAM), developed an index-based crop insurance contract that is more efficient and cost-

effective than traditional crop insurance and can easily be distributed to individual smallholder farmers to increase their access to finance and to protect them and loan providers from weather risk.

The Horn of Africa Risk Transfer for Adaptation (HARITA) pilot project brings together subsistence farmers, NGOs, academics, government and the private sector to explore an innovative approach to community-based climate change adaptation in Ethiopia. HARITA project partners have worked on designing a climate risk management package for smallholders in Ethiopia's northernmost state of Tigray. HARITA aims to foster holistic, community-based adaptation in a replicable and scalable approach and has broken new ground in the field of climate change adaptation and micro-insurance by addressing the needs of poor farmers through a mix of DRR, micro-insurance and credit. The project has established a growing awareness among farmers of the benefits of insurance, and they are starting to request diversified insurance services, in some cases for livestock and fruit.

Kilimo salama Kenya Crop Insurance Programme – smallholder farmers pay a small insurance premium on their purchase of seeds or fertiliser. Partners in the programme include UAP Insurance company, Syngenta Foundation for Sustainable Agriculture and Safaricom. The programme offers small-scale farmers an opportunity to pay a 5 percent insurance premium on their purchase of seeds or fertiliser. The insurance policy protects their investment by calculating losses incurred when insufficient or excess rains are detected by a nearby weather station. (<http://in2eastafrika.net/kenyan-farmers-get-crop-insurance-payouts-after-poor-rains/>). Farmers in Siakago, Embu District, received insurance pay-outs in September 2010 marking the first pay-out by Kilimo Salama. The 135 farmers were paid after weather stations registered that rainfall for the season was below average. Jennifer Mbiro, a 39-year-old mother of four, said that because she did not trust insurance she only insured fertiliser and not the seeds: 'My pay-out is small. This season I've insured my seeds, fertilisers as well as some chemicals that I'm trying for the first time. I now know that it is worth insuring all my inputs.' The pay-outs issued were commensurate with the farmers' projected losses. For example, a 15 percent decrease in yield, based on rain shortfalls recorded at weather stations, triggered a payment of 15 percent. The largest pay-out was KES 2500 (equivalent to \$25 in October 2011). That is the equivalent of about 12 kg of high-yield maize seed, which is enough to plant one acre (0.4 ha). Not all farmers participating in the programme received payment. 'The programme is designed to have enough weather stations so that we can detect variations in rainfall over relatively small areas', said Mr Ferroni, Executive Director of the Syngenta Foundation for Sustainable Agriculture. 'The fact that not all farmers received payments shows that the system can distinguish who suffered damage and who did not. We hope that this high degree of accuracy will attract more farm input companies to participate.'

The programme covers 11,000 farmers in areas including Bungoma, Busia, Eldoret, Embu, Nanyuki, Oyugis, and Homa Bay. Farmers can buy Kilimo Salama cover from local agro-dealers. The 5 percent surcharge translates into about KES 9 to insure a 1-kg bag of improved, high-yield maize seed and KES 25 to insure a 10-kg bag of fertiliser. To cover the full 10 percent premium needed to fund the programme, agro-companies participating in the programme, MEA Fertilisers and Syngenta East Africa Limited, match the farmers' investment. Agro-dealers registered and trained by Kilimo Salama have been equipped with a camera phone, which they use to scan a bar code at the time of input purchase, which registers the policy with

UAP Insurance via Safaricom's mobile data network. This innovative application, developed by Syngenta, then sends a text (SMS) message to the farmer's mobile phone confirming the insurance policy. When data from a particular weather station indicates that rain shortage or other extreme conditions (including excessive rains) are likely to affect harvest, farmers automatically receive pay-outs directly via Safaricom's M-Pesa mobile money-transfer service.

The role of ecosystems in adaptation

WWF's Madagascar and Western Indian Ocean Programme Office is implementing a number of ecosystem-based adaptation activities under the umbrella of 'Ecosystem adaptation: what it is and why it is important to integrate it with community adaptation'. At the same time as communities are experiencing climate change, the natural systems on which they depend are also affected. This is resulting in shifts in the abundance and distribution of species that provide communities with natural resources (eg, fuelwood, timber, foods and medicinal plants). Ecosystem services such as water supplies, crop pollination and protection from natural disasters are also affected. Natural systems need to adapt, just as people do. They can achieve this more easily if other stresses like habitat destruction, overharvesting of resources and pollution are minimised. But as climate change threatens people's livelihoods in rural areas of the developing world, they tend to fall back on natural systems as a safety net. This can further impair these systems' ability to adapt and continue to support human populations. Hence, it is important to plan adaptation holistically, taking into account the needs of both people and nature, and the close interrelationships between them. This means working at larger scales than a single community. The failure to mainstream ecosystem adaptation into community adaptation will risk short-term solutions for people that place increased pressure on the environment, leading to mal-adaptation and worsened conditions for communities in the longer term. Early results from implementation of the WWF projects, which are among the first adaptation activities to be implemented in Madagascar, have allowed conclusions to be reached about the key challenges to effective adaptation, along with the priorities for future adaptation directions.

Value chain approach to climate change adaptation

Ghana's Ministry of Food Security and Agriculture and the Environment Protection Agency have a project 'Promoting Value Chain Approach to Adaptation in Agriculture'. The project aims to promote activities that reduce climate-induced risks to the achievement of food security and income-generation objectives for the rural communities in Ghana. Funding is from GEF under the Special Climate Change Fund (SCCF). The project was approved in November 2010 (GEF 2010).

Appendix 8

A selection of existing smallholder carbon PES schemes

Title	Type of PES and its aims	Driver of demand/ PES scheme initiator	Main actors:	Type of activities funded	Status: active or not
<p>Tanzania Emiti Nibwo Bulora (Trees sustain life)</p> <p>www.planvivo.org/?page_id=2418</p>	<p>Objectives:</p> <ul style="list-style-type: none"> • Diversify income • Improve land use • Reduce poverty • Practise soil conservation • Improve water quality and management • Develop capacities • Adapt to climate change 	<p><i>Initiators:</i></p> <p>Vi Agroforestry Programme (project coordinator) and local farmer groups (producers) and Plan Vivo Foundation (carbon standard)</p>	<p><i>Buyers:</i></p> <p>No Plan Vivo certificates issued yet</p> <p><i>Sellers:</i></p> <p>Producers with Plan Vivo certificates</p> <p><i>Inter-mediaries:</i></p> <p>VI Agro-forestry (Swedish NGO)</p>	<p>The main economic activity in this region was agriculture before the project was implemented. The main cash crops are bananas and coffee. Bananas and beans are the staple food in the area, which are also traditional food and cash crops.</p> <p>Coffee is commonly grown as a cash crop, despite problems of inputs and markets.</p> <p>As a result of the project, agroforestry activities have been implemented: boundary planting, dispersed interplanting, fruit orchards and woodlots</p>	<p>11 years (2009–2020)</p>
<p>Ethiopia: Humbo Assisted Regeneration</p> <p>http://wbcarbonfinance.org/Router.cfm?Page=Projport&ProjID=9625</p>	<p>Aims to restore 2728 ha of natural forest</p>	<p><i>Initiators:</i></p> <p>World Vision in partnership with the World Bank</p>	<p><i>Buyers:</i></p> <p>World Bank Biocarbon Fund</p> <p><i>Sellers:</i></p> <p>Seven forest cooperatives?</p> <p><i>Intermediaries:</i></p> <p>World Vision</p>	<p>Communities have established seven forest cooperatives with legal ownership of the community land. Each cooperative is composed of locals, including both men and women, as well as representatives from World Vision and the Ethiopian Forestry Department. The cooperatives are responsible for managing the land and conducting income-generating activities for the local population.</p>	<p>Active (2007–2017)</p> <p>Expected to continue beyond that</p>

Title	Type of PES and its aims	Driver of demand/ PES scheme initiator	Main actors:	Type of activities funded	Status: active or not
TIST The Inter-national Small Group and Tree Planting Pro-gramme www.tist.org/tist/tanzania.php	TIST empowers small groups of subsistence farmers to reverse the effects of deforestation, drought and famine. Since 1999, TIST participants have been identifying local sustainable-development goals that include tree planting and sustainable agriculture. TIST creates a communication and administrative structure that also addresses health (including HIV/AIDS), education, and nutrition. TIST expects to provide long-term revenue for the small group participants through the sale of GHG credits	Initiators: TIST	<p>Buyers: Anyone can buy certificates on the TIST website or on eBay</p> <p>Sellers: Farmer groups</p> <p>Intermediaries: Clean Air Action Corporation (CAAC)</p>	<p>The project has used farmer-managed natural regeneration (FMNR) techniques. These enable rural communities to assist re-sprouting of native species by identifying, selecting and pruning existing tree and shrub root stocks in the soil. In areas devoid of tree cover, existing vegetation will be enriched by endemic species, including <i>Acacia</i> spp., <i>Aningeria adolffericii</i>, <i>Podocarpus facutus</i>, <i>Olea africana</i> and <i>Cordia africana</i></p> <p>TIST trains and encourages small groups to develop and share 'best practices'. TIST introduces improved farming and land-use techniques to isolated subsistence farmers who are now planting millions of new trees. Using a combination of small-group development and training programmes, and providing small stipends to groups, TIST helps local farmers meet their economic needs, even during severe dry seasons</p> <p>Small groups covenant to meet the programme requirements and ensure tree survival and use of improved, sustainable land-use techniques for years to come. The improved farming practices and tree planting will improve local welfare by stabilising the local food supply and providing families with additional income from TIST tree benefits and payments</p>	Active

Title	Type of PES and its aims	Driver of demand/ PES scheme initiator	Main actors:	Type of activities funded	Status: active or not
<p>Uganda: Trees for Global Benefits http://planvivo.org/34spreview.com/?page_id=45</p>	<p>Aims:</p> <ul style="list-style-type: none"> • Raise awareness of climate change and related issues • Increase household incomes through carbon payments • Offer the farmers technical advice and allow them access to other markets such as timber, fuelwood, fruit, fodder and poles • Conserve biodiversity by promoting indigenous tree species 	<p><i>Initiators:</i> Project developer ECOTRUST (Environmental Trust of Uganda)</p>	<p><i>Buyers:</i> Various buyers of Plan Vivo certificates, eg. 14 buyers^a listed for 2009</p> <p><i>Sellers:</i> Individual producers in 3 districts</p> <p><i>Intermediaries:</i> ECOTRUST</p>	<p>The project is working with established groups of farmers to plan agroforestry and small-scale plantations. Activities include:</p> <ul style="list-style-type: none"> • Planting of mixed native woodlot for timber, including mahogany, cedar, African cherry, laurel and silk trees • Boundary planting for fuelwood and fruit • Protection of wildlife and native forest remnants • Validated by Rainforest Alliance against the 2008 Plan Vivo Standard 	<p>Active since 2003</p>
<p>Kenya: Small-holder Coffee Carbon Project http://siteresources.worldbank.org/INTARD/Resources/335807-1236361651968/Timm_RWsideevent.pdf</p>	<p>Restoring coffee production & producing certified specialty coffee using best coffee practices</p> <p>Reducing climate change vulnerability</p>	<p><i>Initiators:</i> ECOM Agroindustrial Corporation, a leading processor and merchandiser of coffee, cotton and cocoa with ancillary agricultural operations in oilseeds and pigs</p>	<p><i>Buyers:</i> unclear whether any credits have been sold yet</p> <p><i>Sellers:</i> Komothai smallholder farmers cooperation, 9000 members</p> <p><i>Intermediaries:</i> ECOM Agro-industrial Corporation</p>	<p>Potential activities:</p> <ol style="list-style-type: none"> 1. Shade trees, multiple cropping 2. Mulching 3. Fertiliser use efficiency 	<p>???</p>

a. Buyers of Trees for Life Plan Vivo certificates 2009: Tetra Pak, Max Hamburger, U&W [you&we], Satta Kväm, Folksam, Ceramica Sant Agosino Spa, In2 Technology, Classic Africa Safaris, City of London, Blue Green Carbon, Wilson Park.

Title	Type of PES and its aims	Driver of demand/ PES scheme initiator	Main actors:	Type of activities funded	Status: active or not
<p>Kenya: Green Belt Movement http://wbcarbonfinance.org/Router.cfm?Page=Projport &ProjID=9635</p>	<p>Aims to reforest 1876 ha of degraded public and private land with high community access in the Aberdare Range and Mount Kenya watersheds. The project area encompasses lands in the Reserve and in surrounding areas. Lands in the Reserve have been deforested for charcoal production or for conversion to illegal agriculture and cattle grazing</p>	<p><i>Initiators:</i> Green Belt Movement (Kenyan NGO)</p>	<p><i>Buyers:</i> World Bank BioCarbon Fund^b</p> <p><i>Sellers:</i> Community Forest associations?</p> <p><i>Intermediaries:</i> Green Belt Movement</p>	<p>Communities will be organised in Community Forest Associations (CFAs) that will participate in each step of the project and develop management plans. The long-term goal is to use the re-grown forest in a sustainable manner for a variety of products including fuelwood, charcoal, timber and medicinal uses</p>	<p>Active</p>
<p>Kenya: Agricultural Carbon Project http://wbcarbonfinance.org/Router.cfm?Page=BioCF&FID=9708&ItemID=9708&ft=Projects&ProjectID=58099</p>	<p>Adoption of sustainable agricultural land management (SALM) practices by smallholder groups for increased crop yields, farm productivity and soil carbon sequestration (as well as above-ground carbon sequestration) on 45,000 ha</p>	<p><i>Initiators:</i> project developer – VI AgroForestry (Swedish NGO)</p>	<p><i>Buyers/ funders:</i> World Bank BioCarbon Fund^b</p> <p><i>Sellers:</i> Small-holder farmers organised in groups</p> <p><i>Intermediaries:</i> VI Agro-Forestry</p>	<p>Targeting smallholders and small-scale business entrepreneurs organised in farmer groups and primary-level cooperatives. Small-holders will access carbon market and receive additional carbon revenues through adoption of productivity-enhancing practices that also contribute to GHG mitigation. Cropland management (ie, cover crops, crop rotation, mulching, improved fallows, compost management, green manure, agroforestry, organic fertiliser, residue management) and rehabilitation of degraded land</p>	<p>Active</p>

b. World Bank Bio Carbon Fund Tranche 2 participants: **Governments** Government of the Republic of Ireland, Government of Spain. **Companies** Agence Française de Développement France, Davorina Limited (Consensus Business Group) Finance GB, Natsource BioCF II Investments Corporation Asset Management USA, Syngenta Foundation for Sustainable Agriculture, Agriculture Switzerland, Zero Emissions Carbon Trust Energy Spain.

Title	Type of PES and its aims	Driver of demand/ PES scheme initiator	Main actors:	Type of activities funded	Status: active or not
<p>Mali: Acacia Senegal Plantation Project http://siteresources.worldbank.org/INTARD/Resources/3358071236361651968/Timm_RWsideevent.pdf</p>	<p>The project is reforesting around 6000 ha of <i>Acacia senegal</i>, a species endemic to the whole African Sahel, over a 6-year period (2006–2011) in the northern region of Nara</p>	<p><i>Initiators:</i> Deguessi Groupe will be the pivot in the development of the project, with the continued technical support of ICRAF and ICRISAT</p> <p>Close collaboration with the Agricultural Diversification and Competitiveness Program (ADCP) financed by the World Bank. This programme aims to foster better production conditions for agricultural goods in Mali, covering all steps in the production cycle from initial</p>	<p><i>Buyers/ funders:</i> World Bank Biocarbon Fund</p> <p><i>Sellers:</i> Local communities</p> <p><i>Intermediaries:</i> Déguessi Groupe is the project developer and 'carbon aggregator', having signed sub-project agreements with local communities for the commercialisation of the Emission Reductions produced on their lands</p>	<p>Of the 6000 ha, 3000 ha will be developed on private land owned by Déguessi Groupe, a Malian private producer and importer/exporter of agricultural products, and the other 3000 ha will be developed by local communities on communal land under a partnership agreement with Déguessi Groupe. It will develop and manage cost-effective modern nurseries, contribute to farmers' training and assistance for planting trees, maintaining plantations, and gum Arabic harvesting. The project will also re-introduce agricultural activities through intercropping with groundnuts and cowpeas. The project will respond to the disappearance of Mali natural dry forests provoked by clearing way beyond regeneration capacity to meet the growing demand of firewood and cattle grazing. This deforestation has particularly affected gum-producing <i>Acacia senegal</i>.</p>	<p>Active?</p>

Title	Type of PES and its aims	Driver of demand/ PES scheme initiator	Main actors:	Type of activities funded	Status: active or not
		<p>R&D and the development of good practices, to commodity sales and access to domestic and international markets. More particularly, it will support the setting up (over the first 5 years) of a unit dedicated to the implementation of the CDM operations plan, while financing part of the establishment of the community plantations</p>			

a Buyers of Trees for Life Plan Vivo certificates 2009: Tetra Pak, Max Hamburger, U&W Jyou&weJ, Salta Kviám, Folksam, Ceramica Sant'Agosino Spa, In2 Technology, Classic Africa Safaris, City of London, Blue Green Carbon, Wilson Park.

b World Bank Bio Carbon Fund Tranche 2 participants: Governments of the Republic of Ireland, Government of Spain. Companies Agence Française de Développement France, Davorina Limited (Consensus Business Group) Finance GB, NatSource BioCF II Investments Corporation Asset Management USA, Syngenta Foundation for Sustainable Agriculture, Agriculture Switzerland, Zero Emissions Carbon Trust Energy Spain.

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Acronyms and abbreviations

AAS	agricultural advisory services
ACCRA	African Climate Change Resilience Alliance
ADCP	Agricultural Diversification and Competitiveness Program
ADP	Agricultural Development Programme (Nigeria)
AEA	Agricultural Extension Agent
AEDEC	Agriculture Extension Development Coordinator (Malawi)
AFAAS	African Forum for Agricultural Advisory Services
AFOLU	agriculture, forestry and other land use
AIC	Association Interprofessionnelle de Coton (interprofessional cotton growers' association, Benin)
AIDS	acquired immunodeficiency syndrome
AIS	agricultural innovation system(s)
AKIS	agricultural knowledge and information system
ALIN	Arid Lands Information Network
ANCAR	Agence Nationale de Conseil Agricole et Rural (Public–Private National Agricultural and Rural Advisory Agency, Senegal)
AOTL	Alliance One Tanzania Limited
ASDP-L	Agricultural Sector Development Programme – Livestock (Zanzibar, Tanzania)
ASP	Agricultural Service Provider
ASSP	Agricultural Services Support Programme (Zanzibar, Tanzania)
AU	African Union
BERL	Bio Energy Resources Ltd (Malawi)
CAAC	Clean Air Action Corporation
CAADP	Comprehensive Africa Agricultural Development Programme
CADECOM	Catholic Development Commission
CAFOD	Catholic Overseas Development Agency (NGO, UK)
CAN	Climate Action Network
CAR	Carbon Action Reserve
CARD-BT	Churches Action in Relief and Development (NGO, Malawi)
CBES	community-based extension system
CBO	community-based organisation
CCAA	Climate Change Adaptation for Africa
CCAP	Church of Central African Presbyterian
CCB	Climate, Community and Biodiversity (standard)
CCBA	Climate, Community and Biodiversity Association

CCODE	Centre for Community Organisation and Development
CCV	climate change and variability
CCX	Chicago Carbon Exchange
CDKN	Climate and Development Knowledge Network
CDM	Clean Development Mechanism
CECPA	Centres Communaux de Promotion Agricole (Community-level Center for Agricultural Promotion, Benin)
CEPA	Centre for Environmental Policy and Advocacy (Malawi)
CeRPA	Centre Régional pour la Promotion Agricole (Central Region for Agricultural Promotion, Benin)
CFA	Community Forest Association
CGER VALLEE	Centre de Gestion et d'Economie Rurale de vallée du fleuve Sénégal (centre for management and rural economy of the Senegal River valley, Senegal)
CIF	Climate Investment Fund
CLACC	Capacity Strengthening in the Least Developed Countries on Adaptation to Climate Change
CNCR	Conseil National de Concertation et de Coopération des Ruraux (National Council of Cooperation and Rural Agreement, Senegal)
CO ₂ e	carbon dioxide equivalent
CONDES	National Council for Sustainable Development (Mozambique)
COP	Conference of the Parties (UNFCCC)
CRiSTAL	Community-based Risk Screening Tool – Adaptations and Livelihoods
CSIRO	Commonwealth Scientific and Industrial Research Organization (Australia)
CSO	civil society organisation
CSR	corporate social responsibility
CTF	Clean Technology Fund
CV	climate variability
CVCA	Climate Vulnerability and Capacity Analysis
DADO	District Agricultural Development Office / Officer (Malawi)
DADP	District Agricultural Development Plan (Tanzania)
DALDO	District Agricultural and Livestock Development Officer / Office (Tanzania)
DBU	Development Broadcasting Unit (Malawi)
DFID	Department for International Development (UK)
DMP	Desert Margins Program
DRR	disaster risk reduction
EA	Extension Agent
EARO	Ethiopia Agricultural Research Organization
EC	European Commission

ECOTRUST	Environmental Trust of Uganda
ECOWAS	Economic Community of West African States
EIT	Economies In Transition
ENDA-GRAF	Groupe Recherche Action Formation (ENDA-TM, Senegal)
ENDA-TM	Environmental Development Action in the Third World
EO	extension officer
EPA	Environmental Protection Agency
ETI	Ethical Trading Initiative
EU	European Union
EW	extension worker
FAO	Food and Agriculture Organization of the United Nations
FARA	Forum for Agricultural Research in Africa
FASRRD	<i>Fonds d'appui aux services rural régis par la demande</i> (Niger)
FCPF	Forest Carbon Partnership Facility
FFS	farmer field school
FIP	Forest Investment Program
FIPS-Africa	Farm Input Promotion Africa Ltd
FLO	Fairtrade Labelling Organizations International
FMNR	farmer-managed natural regeneration
FO	farmer organisation
FUPRO	Federation des Unions des Producteurs du Bénin (National Federation of Producers' Unions of Benin)
GALS	Gender Action Learning System (Oxfam)
GDP	gross domestic product
GEEREF	Global Energy Efficiency and Renewable Energy Fund (EU)
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Risk Reduction (World Bank)
GHG	greenhouse gas
GHS	Ghanaian cedi (currency)
GIS	geographic information system(s)
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (German Society for International Cooperation) (formerly GTZ)
GSGDA	Ghana Shared Growth and Development Agenda
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit (German Agency for Technical Cooperation) (now GIZ)
GV	village-based farmer organisation (Benin)
GVC	global value chain(s)
GW	Global Water Initiative

HARITA	Horn of Africa Risk Transfer for Adaptation (pilot project, Ethiopia)
HIV	<i>Human immunodeficiency virus</i>
ICRAF	World Agroforestry Centre
ICRISAT	International Crops Research Institute for the Semi-Arid Tropics
ICT	information and communications technology
IDID	Initiatives pour un Développement Intégré Durable (Initiatives for Sustainable Integrated Development; NGO, Benin)
IDRC	International Development Research Centre (Canada)
IED	Innovation Environnement Développement (NGO)
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
IIED	International Institute for Environment and Development
IMF	International Monetary Fund
INGC	Institute of Disaster Management (Mozambique)
IPCC	Intergovernmental Panel on Climate Change
ISEAL	International Social and Environmental Accreditation and Labelling (Alliance)
JI	Joint Implementation
JOCA	Japan Overseas Cooperative Association
JPDM	Justice Peace Development Movement (NGO, Nigeria)
LDC	least-developed country
LDCF	Least Developed Countries Fund (GEF)
LEAD	Local Extension Services for Agricultural Development (CARE project, Ghana)
LEG	Least Developed Countries Expert Group
LOASP	Loi d'Orientation Agro-Sylvo-Pastorale (Senegal)
LUC	land use change
LULUCF	land use, land use change, and forestry
M&E	monitoring and evaluation
MBC	Malawi Broadcasting Corporation
MDG	Millennium Development Goal
MEG	Mountmellick Environmental Group
MICCA	Mitigation of Climate Change in Agriculture (FAO project)
MICOA	Ministry of Environment (Mozambique)
MoA	Ministry of Agriculture
MOFA	Ministry of Food and Agriculture (Ghana)
Mtoe	million tonnes of oil equivalent
MVIWATA	Mtandao wa Vikundi vya Wakulima Tanzania (Tanzania)
MWK	Malawi kwacha (currency)

NAADS	National Agricultural Advisory Services (Uganda)
NABW	National Association of Business Women (Malawi)
NAMA	Nationally Appropriate Mitigation Actions
NAPA	National Adaptation Programme of Action
NASFAM	National Association of Small Farmers (Malawi)
NASSAD	National Agency for Small Scale Agriculture Development
NCAR	National Center for Atmospheric Research (USA)
NCCPF	National Climate Change Policy Framework
nd	no date (used in references and citations for undated documents)
NDFU	North Dakota Farmers Union
NEPAD	New Partnership for Africa's Development
NGO	non-governmental organisation
NICCD	<i>Notes on ICTs, Climate Change and Development</i>
No.	number (of)
Norad	Norwegian Agency for Development Cooperation
NRI	Natural Resources Institute (UK)
ODI	Overseas Development Institute (UK)
OECD	Organization for Economic Co-operation and Development
OWDA	Ogaden Welfare and Development Association
p.a.	per annum (year)
PACJA	Pan African Climate Justice Alliance
PARBCC	Strengthening the Capacity to Adapt to Climate Change in Rural Benin
PDAC	Agricultural Development Programme of the Rural Areas/Communes (Benin)
PDAVV	Diversification Agricole par la Valorisation des Vallées (Diversification of agriculture by promoting valley farming programme, Benin)
PES	payment for environmental services
PPCR	Pilot Program for Climate Resilience (World Bank)
PROAGRI	Agricultural Sector Public Expenditure Program Project (Mozambique)
PRS	poverty-reduction strategy
PRSP	Poverty Reduction Strategy Paper
PSR-SA	<i>Plan stratégique pour la relance du secteur agricole</i> (Strategic Plan for Agricultural Revival, Benin)
PUASA	Emergency food security support programme (Benin)
R&D	research and development
REDD+	reducing emissions from deforestation and forest degradation and enhancing forest carbon stocks
RELC	Research Extension Linkage Committee (Ghana)
REST	Relief Society of Tigray

RIPIMSA	Recherche Interdisciplinaire et Participative sur l'Intégration de Microorganismes dans les Systèmes Agricoles en Afrique de l'Ouest dans le contexte de Changements climatiques
ROPPA	Réseau des organisations paysannes et de producteurs de l'Afrique de l'Ouest (network of farmers' and agricultural producers' organisations of West Africa)
RSPB	Royal Society for the Protection of Birds (NGO, UK)
RSTGA	Rungwe Smallholder Tea Growers Associations (Tanzania)
RTEP	Roots and Tubers Extension Programme (Nigeria)
RTIMP	Roots and Tubers Improvement and Marketing Programme (Ghana)
RUTECO	Rungwe Tea Cooperative Society (Tanzania)
SAGCOT	Southern Agricultural Growth Corridor region (Tanzania)
SALM	sustainable agricultural land management
SAP	structural adjustment programme
SCCF	Special Climate Change Fund (GEF)
SCF	Strategic Climate Fund
SCR	Strengthening Climate Resilience (project)
SDR	<i>Stratégie de Développement Rural</i> (rural development strategy, Niger)
SE/CNEDD	National Environment Council for Sustainable Development (Niger)
SETSAN	Technical Secretariat for Food Security and Nutrition (Mozambique)
SGR	Strategic Grain Reserve (Tanzania)
SIP	Strategic Investment Program
SISO	Sisal Smallholder and Out grower Scheme (Tanzania)
SLM	sustainable land management
SMS	subject-matter specialist; Short Message Service
SOC	soil organic carbon
SPDC	Shell Petroleum Development Company
SRES	Special Report on Emissions Scenarios
SSA	sub-Saharan Africa(n)
SSLPP	Small Scale Livestock Production Programme
SSP	small-scale producer
SWC	soil and water conservation
T&V	training and visit (extension methodology)
TASAF	Tanzania Social Action Fund
TIST	The International Small Group and Tree Planting Programme (NGO)
TLC	Total Land Care
TLTCL	Tanzania Tobacco Leaves Company Limited
UHRF	universal human right to food
UN	United Nations

UNDP	United Nations Development Programme
UNECA	UN Economic Commission for Africa
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UN-REDD	UN Collaborative Program on Reduced Emissions from Deforestation and forest Degradation
VCS	Verified Carbon Standard
VFS	Voices For Food Security (Nigeria)
WACRAD	Word Alive Commission for Relief and Development
WAMU	West African Monetary Union
WATCO	Wakulima Tea Company (Tanzania)
WVI	World Vision International

Endnotes

1. Lands used for agricultural production, including cropland, managed grassland, and permanent crops including agroforestry and bio-energy crops.
2. In the A1FI SRES scenario, which has an emphasis on globally integrated economic growth, areas of major change include the coastal systems of southern and eastern Africa. Under both the A1 and B1 scenarios, mixed rainfed, semi-arid systems are heavily affected by changes in climate in the Sahel. Mixed rainfed and highland perennial systems in the Great Lakes region and other parts of East Africa are also heavily affected. In the B1 SRES scenario, which assumes development within a framework of environmental protection, the impacts are, however, generally less, but marginal areas (eg, the semi-arid systems) become more marginal, with the impacts on coastal systems becoming moderate (Parry et al. 2007).
3. UNFCCC divides countries into three main groups according to differing commitments: Annex I Parties include the industrialised countries that were members of the OECD (Organisation for Economic Co-operation and Development) in 1992, plus countries with economies in transition (EIT Parties), including the Russian Federation, Baltic states, and several central and eastern European states. Annex II Parties consist of the OECD members of Annex I, but not the EIT Parties. They are required to provide financial resources to enable developing countries to undertake emissions-reduction activities under the Convention and to help them adapt to adverse effects of climate change. In addition, they have to 'take all practicable steps' to promote the development and transfer of environmentally friendly technologies to EIT Parties and developing countries. Funding provided by Annex II Parties is channelled mostly through the Convention's financial mechanism.

Non-Annex I Parties are mostly developing countries. Certain groups of developing countries are recognised by the Convention as being especially vulnerable to the adverse impacts of climate change, including countries with lowlying coastal areas and those prone to desertification and drought. Others (such as countries that rely heavily on income from fossil-fuel production and commerce) feel more vulnerable to the potential economic impacts of climate change response measures. The Convention emphasises activities that promise to answer the special needs and concerns of these vulnerable countries, such as investment, insurance and technology transfer.

The 49 Parties classified as least-developed countries (LDCs) by the United Nations are given special consideration under the Convention on account of their limited capacity to respond to climate change and adapt to its adverse effects. Parties are urged to take full account of the special situation of LDCs when considering funding and technology-transfer activities.

4. All rights reserved.
5. WWF and others have stressed that if the world's population consumed the level of resources per capita used by the industrialised world then it would require the resources of three planets to support the Earth's population. Clearly major changes in vision and practice are needed in both the North and the South.
6. World Bank Poverty Net, <http://web.worldbank.org/WBSITE/EXTERNAL/TOPICS/EXTPOVERTY/EXTPRS/0,,contentMDK:22283891~pagePK:210058~piPK:210062~theSitePK:384201,00.html>.
7. The Least Developed Countries Fund was established to support a work programme to assist Least Developed Country Parties (LDCs) carry out, inter alia, the preparation and implementation of national adaptation programmes of action (NAPAs).
8. For example, the DFID-funded Climate Development Knowledge Network (CDKN).
9. In Mozambique this is being implemented in three pilot locations: the Zambezi valley, where the main risk is flood; the Limpopo watershed, where the main risk is drought; and the coastal town of Beira and its corridor, where the main risk is cyclones.
10. The group included well-established players like the Adaptation Learning Mechanism, Eldis, and the World Bank Climate Change Knowledge Portal, as well as newer initiatives like ci-grasp and the Latin

American Carbon Finance Portal. Other regional initiatives included AfricaAdapt and the Asia and Pacific Adaptation Knowledge Platform.

11. The G8 is an economic and political group designed to bring about discussion and effect change among eight of the the world's most powerful nations. It comprises Canada, France, Germany, Italy, Japan, Russia, UK and USA. Representatives from these countries meet annually to discuss economic and other global issues.
12. These were often seen as inadequate in both content and monitoring by NGOs, academics and development practitioners, and this critique in turn led to the emergence of multi-stakeholder initiatives, such as the UK government-funded Ethical Trading Initiative (ETI). The ETI is a tripartite body involving retailers, trade unions and NGOs working on ethical sourcing. It has pushed forward the labour-rights agenda through the development of a base code, learning initiatives, support for third-party auditing, etc.
13. However, there are ongoing concerns regarding smallholder exclusion, particularly by food safety requirements in horticulture, with smallholders keen for responses on issues to do with the terms of trading – rather than narrow compliance on food safety (Nelson 2010).
14. The Suyani Municipal Agricultural Development Unit annual report for 2007 indicated that the approved budget for MOFA by Parliament for 2007 was GHS 1,838,858,392 of which the actual release of approved budget by Parliament was GHS 517,444,500. Some 84 percent of the budget released was used for personal emolument (C:AVA 2008a). Further resources are available in some districts through various projects (eg, Roots and Tubers Improvement and Marketing Programme [RTIMP]).
15. ActionAid (9 staff in 2009); Africare (8 staff in 2009); Catholic Development Commission, CADECOM-Chikwawa (9 staff in 2009); Catholic Development Commission, CADECOM-Diocese of Lilongwe (38 staff in 2009); Churches Action in Relief and Development (CARD-BT, 11 staff in 2009); CARE (40 staff in 2009); Catholic Development Commission (23 staff in 2009); Church of Central African Presbyterian (CCAP) Development Department (17 staff in 2009); Christian Service Committee (3 staff in 2009); Community Youth in Development Activities (9 staff in 2009); Eagles Relief and Development Programme (7 staff in 2009); Emmanuel International (112 staff in 2009); Evangelical Association (7 staff in 2009); FAIR – a joint rural livelihood programme (20 staff in 2009); FAO (17 staff in 2009); Heifer International (8 staff in 2009); Japan Overseas Cooperative Association (JOCA: 4 staff in 2009); Land O'Lakes (4 staff in 2009); Maranatha Ministries (5 staff in 2009); NASFAM (73 staff in 2009); Plan International (11 staff in 2009); Small Scale Livestock Production Programme (SSLPP: over 17 staff in 2009); Sustainable Rural Growth and Development (15 staff in 2009); The Hunger Project (13 staff in 2009); Total Land Care (TLC: 120 staff in 2009); Word Alive Commission for Relief and Development (WACRAD: 15 staff in 2009); World Vision Malawi (WVI); Maleza Centre for Community Organisation and Development (CCODE); Foundation for Irrigation and Sustainable Development; Women In Agri-Business In Sub-Saharan Africa Alliance; National Association of Business Women (NABW).
16. Tanzania NGO capacity: Stathers (2009) identified 36+ international and national NGOs supporting: agricultural production (24), agri-processing (10), capacity strengthening of farmers (27), capacity strengthening of other stakeholders (20), markets (20), microfinance (14), gender and diversity (11), and 11 networks. It is estimated that there are more than 200 NGOs involved in various types of agricultural extension programmes.
17. The World Bank (2006: 40) states that 'In a follow-up of the 2003 agricultural survey, ECON Analysis (2005) finds that rural extension is positively correlated with rural welfare. Notice that Walker et al. (2004) find no significant impact of extension on rural incomes'.
18. An Ondo ADP Extension Agent consulted worked with eight contact groups. Each group consisted of 10 farmers (7 men and 3 women). It is compulsory to have at least three women in a group. The agent had worked with these groups for the previous 5 years (C:AVA 2010b).
19. To reinforce the institutional capacity of small-scale farmers' organisations to engage in policy processes;

Increased investment in agriculture, targeting the Maputo declaration of 10 percent of national budgets to be committed to agriculture, but also the letter and spirit of that declaration which commits to prioritising investment on small-scale agriculture.

Enabling policy, institutional and legislative environment for food security, in particular working towards the harmonisation of national policy framework on agriculture and food security, enabling legislation on right to food and food security, ensuring the insertion of a right to food clause in the constitution, and the establishment of a National Agency for Small Scale Agriculture Development (NASSAD).

20. The World Meteorological Organization is promoting the idea of Global Framework for Climate Services, including Weather Information for All (www.ghf-geneva.org/OurWork/PracticalAction/WeatherInfoforAll/tabid/359/Default.aspx) managed by the Global Humanitarian Forum, which involves scientists, private-sector actors in weather and mobile-phone technologies, and national meteorological services to provide better information to African farmers about weather expected in the coming days and season.
21. An example may be the standards set by the Roundtable on Sustainable Biofuels – see <http://rsb.epfl.ch>.
22. For example, UNFCCC (2007) estimates additional investment and financial flows needed for adaptation in 2030 amount to several tens of billions of dollars. Furthermore, at COP15, Parties cited the paper 'Support needed to fully implement national adaptation programs of action (NAPAs)', prepared by the Least Developed Countries Expert Group (LEG), which indicated a need for financial resources for the full implementation of priorities identified in NAPAs of at least \$1.93 billion during their deliberations with respect to matters relating to least-developed countries.
23. African Forum on Financing for Development Considers Accessing Climate Finance 20 May 2011. <http://climate-l.iisd.org/news/african-forum-on-financing-for-development-considers-accessing-climate-finance/>.
24. The Forum also aimed to shape the African Common Position related to Financing for Development in preparation for the upcoming World Summit in Busan, Republic of Korea, in November 2011, and the High-Level Dialogue on Financing for Development in New York, USA, in December 2011.
25. The Kyoto Protocol was signed in 1997 and came into force in 2005. By July 2010, some 191 states had signed and ratified the protocol.
26. Although almost 20 percent of the projects were based in Africa, this percentage is reduced to only 3.5 percent if projects not registered under any carbon-trading scheme are excluded. While Asia has been the region benefitting most from the CDM, only 11.7 percent of AFOLU projects were based in Asia and Pacific countries. Almost half the AFOLU projects are targeting improved manure management by owners of cattle, poultry or pigs, particularly in Latin America, North America, Asia and the Pacific. In 2006, the average size of such projects was 80,000 pigs or 3500 head of cattle (Varming et al. 2010). Land stewards in North America are the beneficiaries of agricultural or rangeland soil carbon sequestration projects primarily through the CCX scheme.



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AFAAS has the mandate to implement the Agricultural Advisory Services aspects of the Comprehensive Africa Agriculture Development Programme (CAADP) – an Africa-owned and Africa-led initiative through which interventions to transform agriculture are coordinated. The CAADP has four pillars one of which (Pillar IV) addresses agricultural research, technology dissemination and adoption. Leadership of the implementation of this Pillar is mandated to the Forum for Agricultural Research in Africa (FARA). In this context AFAAS operates under the umbrella of FARA but has its own autonomy and governance structure.