Climate Learning for African Agriculture: Working Paper No.1

Exploring the links between Climate Change, Agriculture & Development: A Briefing Paper

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for African agriculture

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Key messages

The scale of the challenges posed by climate change requires urgent action. Agriculture is both a major cause of global warming, and will be significantly affected by it. More demands are now being placed upon agriculture: global food security, responding to climate change, protecting environmental services. This presents both challenges and opportunities to policy-makers and practitioners.

Many climate change adaptation or mitigation initiatives have been project-based activities – but this is insufficient. Climate change responses require more coordinated action amongst relevant stakeholders across different scales. Planning and capacity strengthening has to be integrated into government policy-making in a coherent fashion. Responding to climate change requires consideration of the implications for trade flows as well as production impacts. Economic models may need to be revisited. Climate change challenges need to be understood as they interact with other major development processes (e.g. globalisation, de-agrarianisation, urbanisation, migration).

More integrated or holistic conceptual frameworks have emerged in recent years, which seek to combine more specific climate change responses (e.g. particular mitigation technologies) with shorter and longer term *development* objectives. Proponents of existing concepts, such as sustainable agriculture, increasingly recognize climate change issues. The green economy concept suggests that future economic development and the securing of environmental services are intertwined. In the agricultural sector, the broad concept of Climate Smart Agriculture is moving to the fore. It merges productivity, adaptation, mitigation and climate resilience, alongside broader development goals.

There is a crowded field of climate change and related concepts which jostle for attention. Each concept has its own promoters and opponents – some more powerful than others. The broad nature of the concepts allows for varied interpretations in implementation, encourages inclusiveness and sparks debate. Conversely broad definitions risk masking real differences in development visions including questions of participation, power and equity, the forms of technology and institutions involved, the role of markets and national autonomy. Too open a definition could prevent recognition of the need for more game changing action.

Making these concepts operational presents many challenges, not least building consensus, creating the right incentives and enabling conditions. Climate change may only be adding to the challenges facing agriculture, but could also act as a catalyst, alongside other global concerns, to create fresh opportunities for sustainable agricultural development.

Mwitikilwa village (Tanzania) climate change learning group member explaining use of the group's newly installed weather station[i].

1. Introduction

Agriculture is one of the most important drivers of global warming, as well as a critical sector that will be affected by climate change. The Climate Learning project is a joint partnership between AFAAS, FARA and the NRI, funded by the CDKN. The project aims to support a shared learning process with agricultural research and advisory service stakeholders across Africa on responding to climate change and the implications for policies, practices and roles. In this paper we explore the most important climate change concepts and frameworks relevant to agriculture and development, seeking to identify how each might be applied to agriculture.

2. Sustaining agriculture

Rising concerns over past decades over the environmental and social impacts of conventional agriculture (e.g. biodiversity losses & pollution from pesticides), especially in industrialized countries, led to the emergence of the concept of sustainable agriculture. These concerns are being felt more globally, as industrialization and awareness spreads.

There are diverse definitions of **sustainable agriculture,** with many drawing upon the idea of three pillars (social, economic and environmental) and the 1987 Brundtland definition of sustainable development – '*development that meets the needs of the present without compromising the ability of future generations to meet their own needs'*.

An example definition is that of Pretty (2008[ii]): 'sustainable agricultural *systems tend to have a positive effect on natural, social and human capital, while unsustainable ones feedback to deplete these assets, leaving fewer for future generations. For example, an agricultural system that erodes soil while producing food externalizes costs that others must bear. But one that sequesters carbon in soils through organic matter accumulation helps to mediate climate change*'. This recent definition illustrates how climate concerns are being integrated into existing frameworks.

Agroecology is a term which emerged in the 1930s, and was initially focused on crop production and protection aspects, but with broader environmental, social, economic, ethical and development issues becoming relevant in recent years. Today, the term 'agroecology' is used to mean either a scientific discipline, agricultural practice, or a political or social movement[iii]. The science of agroecology may be defined as the application of ecological concepts and principles to the design and management of sustainable agroecosystems and it provides a framework to assess the complexity of agroecosystems.[iv]

Promoting **sustainable intensification** was one of the twelve key priorities for action for policy makers identified by the Foresight: The Future of Food and Farming (2011) report which states: '*It follows that if (i) there is relatively little new land for agriculture, (ii) more food needs to be produced and (iii) achieving sustainability is critical, then sustainable intensification is a priority. Sustainable intensification means simultaneously raising yields, increasing the efficiency with which inputs are used and reducing the negative environmental effects of food production'.*

3. Multiple demands

Multiple demands are now being placed upon agriculture lands, which occupy over one third of the Earth's land area (Smith 2008). Agriculture is a mainstay of many developing country economies and forms the basis of millions of people's livelihoods. There is now renewed attention to achieving global food security after the food crisis of 2008 and due to increasing recognition of challenges such as climate change and environmental degradation that form barriers to feeding global populations.

Other goals beyond increasing productivity, food production and food security include:

- Being resilient to climate change (coping with and recovering from shocks and stresses);
- Reducing greenhouse gas emissions from agricultural activities, because these emissions contribute to global warming;
- Recognising that natural resources are finite and supporting the provision of not only food and fibre, but other ecosystem services (e.g. water, biodiversity, soil) upon which we all depend;
- Diversifying away from fossil fuel based growth, because these resources are finite and cause global warming;
- Promoting rural employment, value added, growth and poverty reduction in developing countries.

4. Responding to climate change – a crowded field

Multiple concepts are circulating in international debates in response to climate change challenges and which are relevant to or focussed on agriculture. Some of these concepts arose independently in response to broader environmental challenges (e.g. sustainable agriculture, agroecology) and can be traced back many decades. Others have emerged in direct response to climate imperatives and are more recent, e.g.: mitigation, adaptation, resilience, green economy, low carbon

development, climate smart agriculture and climate compatible development. Climate smart agriculture is the primary concept that relates specifically to the agricultural sector, but there is a large body of work on climate change mitigation and agriculture [v] and agricultural adaptation[vi].

Definitions for these concepts are rarely precise or uncontested. New language (some might say jargon) is often created and sometimes the definition for one concept draws on other climate related concepts, which themselves are not clearly defined or there is limited consensus on the definition. Even the Intergovernmental Panel on Climate Change (IPCC) – the key international scientific body working on climate change – has different definitions for some concepts in different publications. This has led to some confusion, but there are instances of consensus and some suggest that the existence of the IPCC provides more rapid consensus than exists in other fields of development[vii] . This is aided by the high level of attention being paid to climate change in development and climate research and practitioner communities and the international negotiations (which also bring together academics and NGOs as well as government representatives).

Table 1 provides a summary of key concepts in climate change and agriculture, and attempts to provide a brief summary of where each concept has originated from, what proponents mean by it and where there is disagreement. The second column provides example definitions.

Mitigation was one of the earliest concepts to be developed, because it is a direct response to human induced climate change – essentially finding ways to reduce levels of greenhouse gases (GHG) which are causing global warming. Any process, activity or mechanism which removes GHGs from the atmosphere is referred to as a sink (See IPCC 2007b). Agriculture will not only be negatively affected by climatic change, it is also a major cause of global warming (10-12% of GHGs, not including the effect of forest clearance). Agriculture has the potential to contribute to mitigation in three key ways: (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.

However, **adaptation** – addressing the anticipated and actual impacts of climate change - has followed soon after as vulnerability to climate change became an increasing concern, particularly in the international negotiations, and as social scientists entered the fray alongside climate scientists. While poverty and vulnerability to climate change are not synonymous, there has been increasing recognition that poorer people and communities, in particular, will have fewer

resources to adapt to climate change. Their livelihoods may be dependent on climate-sensitive resources and are quite likely to be located in fragile environments.

Climate change agricultural adaptation action research a sunflower variety trial in central Tanzania (T. Stathers)

Maladaption - 'an adaptation that does not succeed in reducing vulnerability but increases it instead'[viii]-has been noted as a potential outcome of current 'business as usual' strategies and of intended adaptations that do not adequately take into account longer-term climatic change (rather than just increasing climatic variability) and because of the uncertainties inherent in climate change projections. Possible 'limits to adaptation' (not only physical and economic, but social, cultural and political) have also been outlined[ix]. In agriculture, farm level changes will be needed, but also institutional shifts[x]. As well as innovation in technologies, shifts in policy, capacity and mindset are also required, with learning required to respond to the uncertainties of climate change.

Climate resilience - the ability of households and communities to recover from shocks and stresses = emerged as a popular term in the late 2000s, partly picking up on work by systems theorists that seek to understand how complex ecosystems change, and in recognition of the intertwined nature of social and ecological processes. The term social-ecological system has emerged as a result. While ecosystems and people face different types of shocks and stresses, the increasing pressures and shocks associated with climate change have meant that resilience thinking has had quite an influence on shaping international debates and practice on responding to climate change. Adaptations that leave communities vulnerable to shocks and stresses are likely to be 'maladaptive': and hence the importance of increasing resilience (e.g. by spreading risk, diversifying activities and species, preparing for more frequent extreme events).

While mitigation and adaptation, and to some extent resilience, have emerged separately in recent years there has been a degree of integration. The fourth IPCC report dedicated a whole chapter[xi] to identifying the interactions between

adaptation and mitigation and since then increasing efforts have been made to identify co-benefits, to consider landscape management approaches and to promote more strategic, higher level responses rather than projects and programmes alone. Multiple goals are being brought together under umbrella terms. The many possible trade-offs and synergies involved are starting to be being explored.

5. Integrating concepts – the rise of Climate Smart Agriculture

Climate Smart Agriculture (CSA) is one of the concepts that is gaining increasing attention, not least because of its promotion by key international bodies, including FAO which coined the term, as well as the World Bank and Rockefeller Foundation. CSA has quite a broad definition and draws together sustainable productivity, resilience (adaptation), emissions reductions, national food security and development goals under one umbrella. The aim is to find integrated strategies, although it is recognized that it may not be possible to achieve all goals simultaneously in each location[xii] Figure 1 below illustrates some examples of possible goals of agriculture and how they might overlap..

The concept of CSA is gaining increasing popularity as a potential unifying concept for policy, institutional arrangements, and funding channels for responding to climate change, food security, and other development goals. However, considerable challenges remain. For some, CSA represents an attempt to promote industrial agriculture. For example, Simon Mwamba of the East African Small Scale Farmers' Federation talking at the recent Durban climate change talks explains: '*Climate Smart Agriculture is being presented as sustainable agriculture – but the term is so broad that we fear it is a front for promoting industrial, 'green revolution' agriculture too, which traps farmers into cycles of debt and poverty*'"[xiii]. For others, CSA is perceived as a threat to modernising of agricultural and achieving food security. There are concerns with the emphasis on mitigation - the technical mitigation potentials and payments for carbon services to farmers. CSA presents potentially new funding opportunities but will require strong political leadership, supportive government policies and institutional arrangements that make investments worthwhile. These are challenges already central to debates on agricultural development for many decades.

The **green economy (GE)** concept has attracted much attention in the run up to the Rio+20 conference. There are diverse origins and interpretations of the concept amongst both supporters and opponents of GE – See Table 1.

UNEP's Green Economy report states that '*the greening of economies has the potential to be a new engine of growth, a net generator of decent jobs and a vital strategy to eliminate persistent poverty*'. . Further, UNEP suggest that the greening of agriculture refers to '*the increasing use of farming practices and technologies that simultaneously: (i) maintain and increase farm productivity and profitability while ensuring the provision of food on a sustainable basis, (ii) reduce negative externalities and gradually lead to positive ones, and (iii) rebuild ecological resources (i.e. soil, water, air and biodiversity "natural capital" assets) by reducing pollution and using resources more efficiently*'.

Most African countries' economic, poverty reduction and food security strategies are based on increasing agricultural production through conventional high input intensification and /or expansion into uncultivated land. UNEP suggest that the GE approach potentially offers a more sustainable way forward and the opportunity for technological 'leap frogging' and innovation. At this stage, however, GE means very different things to different interested parties and this has raised concerns amongst G77[xiv] countries in relation to sustainable development and poverty eradication goals and with regard to the potential misuse of GE for "green protectionism" and as a means of introducing new conditionalities in financing for developing countries. What GE could mean for African agriculture and different social groups thus remains an open question.

Climate Compatible Development (CCD) CCD is a relatively recent concept which has been developed and promoted by the Climate Development Knowledge Network or CDKN, a consortium funded by the UK's Department for International Development (DFID). It reflects earlier work noting the importance not only of mitigation and adaptation in response to climate change, but of finding co-benefits t and of the need to consider the implications of climate change not only through adaptation and mitigation programmes and policies, but as part of mainstream development responses and policy frontiers . The network has been set up to support decision-makers to design and deliver CCD, but what exactly is CCD? It is defined by Mitchell and Maxwell (2010) as '*an approach which 'minimises the harm caused by climate impacts, while maximising the many human development opportunities presented by a low emissions, more resilient, future*'. Climate change and responses to it are changing patterns of innovation, trade, production, population distribution and risk in complex ways. 'Triple win' strategies are sought that result in low emissions, build resilience and promote development simultaneously (Mitchell and Maxwell, ibid).

5. Discussion

Agriculture is one of the most important causes of global warming, as well as a critical sector that will be affected by climate change. Multiple demands are being placed upon agriculture (including food security, importance to livelihoods and economies in most developing countries and provision of other ecosystem services) in the context of finite limits of natural resources, demographic pressures, the threat of climate change, the need for conservation of resources and the importance of ecological processes and tipping points.

While adaptation or mitigation projects can be important sources of learning, more programmatic and mainstream planning responses are needed. Attention needs to be paid not only to productivity issues, but also to how climate change may change value chains and global trade flows. Some commentators suggest that climate change uncertainties require a revisiting of prevailing economic models and assumptions – to avoid lock-in to unsustainable pathways. There is also a need to understand climate change within broader development processes (e.g. de-agrarianisation, urbanisation, migration, globalisation, changing balance of economic and political power, volatility in global financial markets etc), because these may compound or significantly outweigh climate related challenges and add to the uncertainties that lie ahead.

More integrated or holistic conceptual frameworks have been developed and presented of late, in an attempt to combine climate change responses and shorter and longer term development objectives. For example, proponents of existing concepts such as sustainable agriculture increasingly recognize climate change issues. The green economy concept suggests that securing future economic development and protecting or enhancing environmental services are intertwined. Some organisations are promoting concepts such as Climate Smart Agriculture, which bring together responses to climate change (e.g. adaptation, mitigation, resilience) alongside broader development goals. However, as a result of merging multiple objectives these concepts can appear somewhat ambitious in terms of implementation. Figure 1 below shows how food production, adaptation and mitigation goals might overlap and gives examples of possible practices for each goal, but also activities which could represent dual or triple wins.

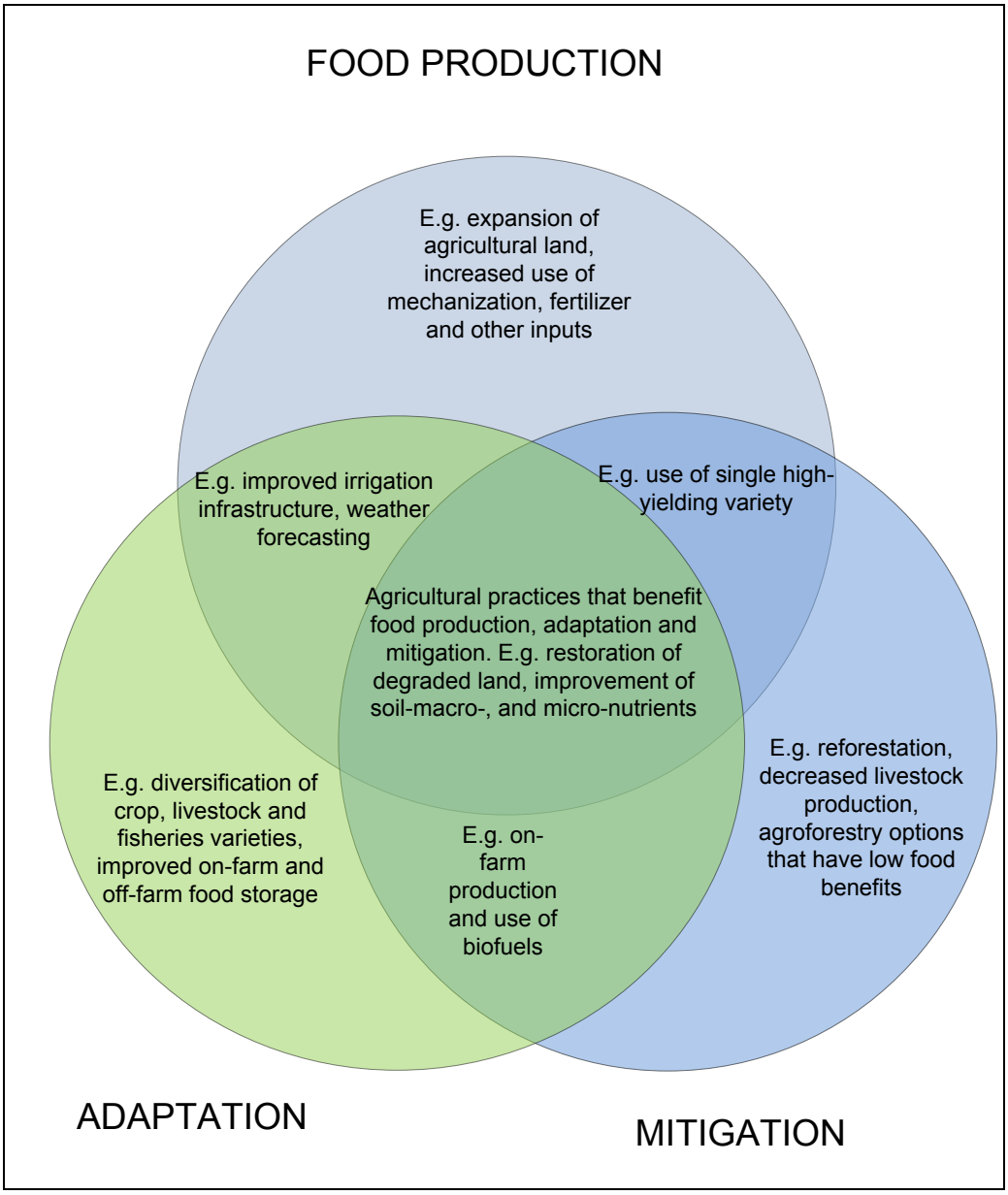

Figure 1: Potential synergies and trade-offs among food production, adaptation and mitigation (Meridian Institute 2011: 16)

Figure 1 focuses largely on technological innovations and to some extent land use change. Institutional innovation will be equally important (e.g. climate index insurance, climate-based social protection programmes, climate farmer field schools). The term 'adaptation' here refers to approaches and capabilities within agriculture, and does not include more radical shifts such as 'getting out of farming', which may be the most effective adaptation to climate change for farmers in particularly vulnerable contexts (Meridian 2011). Implementation of different options will have varying outcomes at different scales. There will also be trade offs in decision making and outcomes for different social groups now and in the future.

There is thus a crowded field of climate change and related concepts jostling for attention. Each concept has its own promoters and opponents – some more powerful than others. The competition between concepts is probably unavoidable, but it can create confusion, especially for those trying to implement change in practice – whether policy-makers or practitioners. Integrated approaches such as Climate Smart Agriculture and Climate Compatible Development highlight the importance of *trade-offs and synergies* in decision making related to agriculture. Although the Climate Smart Agriculture approach is already broad and explicitly mentions sustainable agricultural production, adaptation and mitigation, there is relatively little emphasis on other aspects of food/agriculture value chains, economic models, trade, and broader institutional issues in adaptation. Climate Compatible Development brings into focus questions pertaining to economic policy, longer-term horizons in development planning, and issues of (inter-generational) equity, by focusing not only on production, but also trade, social protection, economic policy, investment, migration etc. Green Economy is a concept that also raises questions about central economic policy and in some interpretations has similarities with Climate Compatible Development.

The broad nature of the concepts allows for varied interpretations in implementation, encourages inclusiveness and sparks debate. Conversely broad definitions risk masking real differences in development visions[xv] including questions of participation, the forms of technology to be used, the role of markets and national autonomy. Thus, too open a definition could prevent recognition of the need for more radical, game changing action.

Considerations in making these concepts operational include building consensus amongst relevant stakeholders for change at the appropriate spatial scale (e.g. farm, community, water catchment, value chain, local government area, national, global) and time scale (immediate to long term). Finding appropriate ways to measure progress in responding to climate change adaptation is particularly challenging, but urgently needed to make progress visible and to enhance learning..

The climate change and agriculture challenges are many, and the incentives and enabling conditions are complex and often tantalizingly difficult to bring about. Climate change may only be adding to the challenges facing agriculture or more optimistically, it may also act as a catalyst, alongside other global concerns, to create fresh opportunities for sustainable agricultural development.

Table 1: Key Climate Change Concepts in Agriculture	
Concept origins	**Example definitions**
Mitigation	
Climate scientists have found that global greenhouse gas (GHG) emissions have grown since pre-industrial times, with an increase of 70% between 1970 and 2004 (IPCC 2007a[xvi]) and conclude that climate change is being caused by human activities which create emissions. The UN defines mitigation in the context of climate change, as a human intervention to reduce the sources or enhance the sinks of greenhouse gases.	IPCC: 'Technological change and substitution that reduce resource inputs and emissions per unit of output. Although several social, economic and technological policies would produce an emission reduction, with respect to climate change, mitigation means implementing policies to reduce GHG emissions and enhance sinks' (IPCC 2007b[xvii]). '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' (IPCC 2007c[xviii]).
Adaptation	
Diverse disciplinary roots. IPCC defines it in relation to climate change, but diverse interpretations exist. Adaptation was preceded by work on coping strategies as social responses to environmental stresses and shocks. Large body of work defining, exploring, implementing and evaluating adaptation across scales in different ways	'Adjustment in natural or human systems in response to actual or expected climatic stimuli or their effects, which moderates harm or exploits beneficial opportunities (IPCC 2007c'[xix]). Or 'the process through which an actor is able to reflect upon and enact change in those practices and underlying institutions that generate root and proximate causes of risk, frame capacity to cope and further rounds of adaptation to climate change'[xx] (Pelling)
Sustainable intensification	
Global food demand is increasing, but neither conventional intensification or extensification provide viable options in the face of resource scarcity and need to enhance environmental services. This has led to the notion of sustainable intensification. (i) If there is relatively little new land for agriculture, (ii) more food needs to be produced and (iii) achieving sustainability is critical, then sustainable intensification is a priority. Promoting SI is 1 of 12 key priorities for policy makers[xxi] according to this report. But divergent views on questions of participation, the forms of technology to be deployed, the role of markets and national autonomy[xxii]	'Intensification using natural, social and human capital assets, combined with the use of best available technologies and inputs (best genotypes and best ecological management) that minimise or eliminate harm to the environment, can be termed "sustainable intensification"(Pretty 2008) and 'producing more output from the same area of land while reducing the negative environmental impacts and at the same time increasing contributions to natural capital and the flow of environmental services' Pretty el al (2011 [xxiii])
Climate resilience	
Climate resilience is a concept that has drawn on the disaster risk thinking and socio-ecological systems (SES) theory. Alongside adaptive capacity, resilience indicates a more positive attribute than vulnerability – which has been criticized for presenting people as victims, rather than as active agents with capabilities	Resilience can be used loosely in the climate change literature as the ability of households and communities to recover from shocks and stresses. But it is used more precisely in a systems sense: referring to the 'regenerative abilities of a system and its capacity to maintain desired functions in the face of shocks and stresses (Pelling 2011). ' Resilient dimensions of a system including diversity, social networks, innovation, redundancy, ecosystem services, tight feedbacks, modularity, overlapping governance, and acknowledging slow variables[xxiv]. The IPCC IV Synthesis report defines resilience as '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'.
Climate Smart Agriculture	
CSA concept originated from the FAO (FAO 2010[xxv]) and now has widespread support from other development agencies, (e.g. the World Bank and the Rockefeller Foundation, with several high profile events held in 2011)	CSA is defined by the FAO (2010) as: 'agriculture that sustainably increases productivity, resilience (adaptation), reduces/removes GHGs (mitigation), and enhances achievement of national food security and development goals'.

Table 1 (cont): Key Climate Change Concepts in Agriculture	
Concept origins	**Example definitions**
Green Economy	
The concept emerged from several strands of debate [xxvi]i) Environmental technology sector - innovation policy and future economic development[xxvii]; ii)Green Jobs (addressing the issues of conserving the natural environment and providing decent jobs); iii) Beyond Growth (questions the necessity of growth as a precondition for prosperity and GDP as a measure for well-being[xxviii]). v) Economic Valuation of Ecosystem Services (ES) (putting economic value on ES give insights into policy options, but there are limitations of such valuations)[xxix]	A green economy is defined as "as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities"[xxx]. A recent FAO document refers to the process of Greening the Economy with Agriculture (GEA) and tentatively suggest this means "increasing food security (in terms of food availability, access, stability and utilisation) while using less natural resources, through improved efficiency, resilience and equity throughout the food value chain"[xxxi]
Climate Compatible Development (CCD)	
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[xxxii]. Triple win' strategies are sought that result in low emissions, build resilience and promote development simultaneously	An approach which 'minimises the harm caused by climate impacts, while maximising the many human development opportunities presented by a low emissions, more resilient, future. It moves beyond the separation of adaptation, mitigation and development strategies and focuses on climate strategies that embrace development goals and on development strategies that respond to a changing climate. This represents a 'new generation of development processes that safeguard development from climate impacts (climate resilient development) and reduce or keep emissions low without compromising development goals (low emissions development)'. '

[i] Pictures are from DFID IDRC funded 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.

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iv Altieri Miguel A. and Clara I. Nicholis (2005) Agroecology and the Search for a Truly Sustainable Agriculture, UNEP, Mexico.http://www.agroeco.org/doc/agroecology-engl-PNUMA.pdf.

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[xiii] http://www.climate-justice-now.org/climate-smart-agriculture-and-carbon-markets-will-be-a-disaster-for-africa-groups-warn-against-zuma%e2%80%99s-agriculture-prize-at-cop17/

[xiv] The Group of 77 is the largest intergovernmental organization of developing countries in the United Nations, which provides the means for the countries of the South to articulate and promote their collective economic interests and enhance their joint negotiating capacity on all major international economic issues within the United Nations system, and promote South-South cooperation for development.

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[xvii] See Annex 2 Glossary. IPCC (2007b) Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II and III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, Pachauri, R.K and Reisinger, A. (eds.)]. IPCC, Geneva, Switzerland, 104 pp.

[xviii] See Appendix 1 Glossary IPCC (2007c) Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge, UK, 976pp.

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