Climate Change and Developing Country Agriculture:

An Overview of Expected Impacts, Adaptation and Mitigation Challenges, and Funding Requirements

Issue Brief No. 2

By Jodie Keane,
Overseas Development Institute

Sheila Page,
Overseas Development Institute

Alpha Kergna,
Institut d'Economie Rurale (IER)

Jane Kennan,
Overseas Development Institute

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International Centre for Trade and Sustainable Development

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International Centre for Trade and Sustainable Development (ICTSD)
International Envrionment House 2
7 Chemin de Balexert, 1219 Geneva, Switzerland
Tel: +41 22 917 8492 Fax: +41 22 917 8093
E-mail: ictsd@ictsd.ch
Visit ICTSD's website at: www.ictsd.org

And

International Food & Agricultural Trade Policy Council (IPC)
1616 P St., NW, Suite 100, Washington, DC 20036, USA
Tel +1 202 328 5056 Fax +1 202 328 5133
Email: agritrade@agritrade.org
Visit IPC's website at www.agritrade.org

Charlotte Hebebrand, President/CEO of IPC, and Marie Chamay Peyramayou, Manager of the ICTSD Global Platform on Climate Change, Trade Policies and Sustainable Energy, are the persons responsible for this initiative.

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ICTSD and IPC welcome feedback and comments on this document. These can be forwarded to Marie Chamay Peyramayou, mchamay@ictsd.ch and/or Christine St Pierre, stpierre@agritrade.org.

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ABBREVIATIONS

AAU	Assigned Amount Unit
AF	Adaptation Fund
AR4	Fourth Assessment Report
CDM	Clean Development Mechanism
CER	Certified Emissions Reduction credit
CIF	Climate Investment Fund
CRS	Creditor Reporting System
EC	European Commission
ETF-IW	Environmental Transformation Fund-International Window
FAO	Food and Agricultural Organisation of the United Nations
GCM	General Circulation Model
GEF	Global Environmental Fund
GHG	Greenhouse Gas
GWP	Global Warming Potential
IATAL	International Air Travel Adaptation Levy
ICAO	International Civil Aviation Organization
IDA	International Development Association
IMERS	International Maritime Emission Reduction Scheme
IPCC	Intergovernmental Panel on Climate Change
ITU	International Telecommunications Union
LDC	Least Developed Country
LDCF	Least Developed Countries Fund
LUCF	Land Use Changes and Forestry
MEA	Multilateral Environmental Agreement
MDG	Millennium Development Goal
NAPA	National Adaptation Plans of Action
ODA	Official Development Assistance
OECD-DAC	Organisation for Economic Cooperation and Development-Development Assistance Committee
REDD	Reduced Emissions From Deforestation
SCCF	Special Climate Change Fund
SPA	Special Priority on Adaptation
UNCTAD	United Nations Conference on Trade and Development
UNDP	United Nations Development Program
UNECLAC	United Nations Economic Commission for Latin America and the Caribbean
UNEP	United Nations Environment Programme
UNIDO	United Nations Industrial Development Organization
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
WTO	World Trade Organization

FOREWORD

Climate change will have a major impact on agricultural production, comparative advantages, and trade flows. A greater divergence between regions in terms of agricultural output is likely. For the most part, countries in the tropics and subtropical zones, mostly developing economies, are expected to lose in terms of agricultural production whereas countries in temperate zones, mostly developed economies, are expected to gain. Many of these developing countries are highly dependent on the production and exports of agricultural goods, climate change will therefore cause considerable losses of growth and export opportunities. In addition, most of the worst affected countries are characterized by current crippling infrastructure, feeble rural and agricultural markets and, weak integration to the global economy.

It is generally agreed that the countries in Africa will experience declining yields in the long run. For example, agricultural production in Guinea-Bissau, which agricultural sector adds value of 62% of GDP, is estimated to decrease with 32.7 % (without carbon fertilization) by 2080. The impacts on development and food security, as well as on nutrition, will be enormous.

The international community has agreed to give priority to mitigation and adaptation efforts geared towards addressing such distress. Moreover, securing adequate resources and identifying ways and means to redress a trend towards an eventual catastrophe is urgent and imperative. The current paper investigates ways in which the affected developing countries can secure alternative sources of export earnings. In doing this, the paper goes beyond the option of 'climate change proofing' of existing products, methods of production and logistics; it also investigates the possibilities of diversifying into new products, methods of production and new tradable services. As a part of the transition towards a low carbon global economy, new products, such as carbon, and services, such as standard setting and verification of carbon emissions, are demanded.

However, the question remains with respect to how projects supporting these efforts can be financed. Current available and proposed mitigation finance remains considerably lower than the projected costs of mitigation in developing countries. The paper discussed the possibility of linking Aid for Trade and aid directed at mitigating and adapting to the effects of climate change on agricultural production in developing countries. It is shown that these two forms of aid have many similarities and that linking them is viable, and could create more coherence. Further, it is stressed that these two forms of targeted aid should be additional from normal ODA, but that, at the same time, they should not be separate.

Creating coherence with respect to aid is especially important considering the current lack of coordination between the overall international regimes dealing with trade and climate change. Such a lack will unnecessarily punish the receivers of financial aid.

The ICTSD–IPC Platform on Climate Change, Agriculture and Trade is pleased to release this paper, trusting that it will contribute to a better understanding of these complex linkages and their treatment in the current negotiations in the international climate and trade fora.

Ricardo Meléndez-Ortiz
Chief Executive, ICTSD

Charlotte Hebebrand,
President /CEO, IPC

EXECUTIVE SUMMARY

Agricultural trade flows depend on the interaction between trade policy and inherent comparative advantage. Not only is the agricultural sector highly vulnerable to climate change, it is also one of the sectors most distorted and heavily influenced by a wide range of local, regional, national and international trade policies. The increased stress to the system brought about by climate change makes reform in global agricultural policies arguably even more important.[1]

Even if the most ambitious climate change mitigation measures are adopted, global temperatures are likely to increase by at least 2^{O}C, compared with pre-industrial levels, by the end of this century, if not sooner.[2] The intensity and frequency of extreme climatic conditions are expected to increase and the predictability of normal rainy seasons decrease.[3] Poor countries with large rural economies depend on agricultural exports for their fiscal and socio-political stability (Christoplos 2009); agricultural export earnings may be jeopardised unless alternatives are sought or 'climate proof' investments are made.

But what are the alternative sources of export earnings? Given the potential impact of climate change on agricultural production, this document sets out to assess how producers might adapt, this includes in relation to the new market opportunities for goods and services that are likely to arise from efforts to mitigate climate change, as well as to climate change itself.. It identifies the scope for climate change finance and existing trade facilitation mechanisms, such as Aid for Trade, to work together to address the challenges posed by climate change to the agriculture sector in poor countries.

Technical assistance for trade aims to help developing countries design and implement trade policy effectively and to help producers within these countries be competitive, given the policies, markets, products, and conditions which face them, now and in the future. Climate change and the international conventions and agreements that respond to it will affect what is produced, what is traded, trading rules, the standards traded goods must meet, and the regulations they must follow.

Country-specific studies on the climate change impacts expected for the agricultural sector in most low income countries are scarce, in part due to a lack of data availability. Where country-specific studies do exist, they typically analyse a limited number of crops and cereals feature most prominently. Although such crops are important in terms of global agricultural trade flows, reductions in agricultural output and productivity because of climate change will affect more than just cereals. Some of the economies most dependent on agriculture face an estimated loss of more than 50 percent of their total agricultural output by 2080, even when including carbon fertilisation effects (where an increased concentration of carbon dioxide in the atmosphere acts as a stimulus to crop productivity). Countries such as Malawi may need to adapt to a 20 percent reduction in agricultural export earnings because of reduced agricultural output as a result of climate change.

Beyond 'climate proofing' existing modes of production and investment, for which global 'top down' estimates exist, but for which 'bottom up' estimates are largely limited, other adaptation options may include those that relate to the transition to a low-carbon global economy. Worldwide, new products and services are being demanded as part of the transition towards a low-carbon global economy. Out of the total greenhouse gas (GHG) abatement opportunities and mitigation measures identified by McKinsey (2009) that need to be undertaken and adopted in order to avoid dangerous climate change, 70 percent are located in the developing world. Fully 90 percent of all 'terrestrial carbon'[4] opportunities are located in the developing world and these opportunities and measures account for 30 percent of total GHG abatement opportunities.

It is highly likely that avoided deforestation (Reduced Emissions from Deforestation and Forest Degradation or REDD) will be included in the next commitment period of the Clean Development Mechanism (CDM). But recognition of *all* types of terrestrial carbon could offer primarily agriculturally based societies, such as low income countries, potential new market opportunities in carbon trade and sources of income.

Though the international architecture for financing climate change mitigation and adaptation is new and growing, there is a considerable gap between identified needs and current pledges. There is also considerable variation in terms of the focus of funds. Nevertheless, mitigation finance available through the Clean Development Mechanism (CDM) has been the largest source of mitigation finance to developing countries to date. Efforts should be made to increase access to the mechanism by low income countries; these efforts should increase both the scope and scale of this access.

The transition to a low-carbon economy will likely require that low-carbon products be certified as such. If certification is undertaken using lifecycle analysis, which is the more objective, but inevitably more costly, methodology, some developing country agricultural exporters may benefit from the relocation of agricultural production from high- to low-emitting locations. However, without a well-designed and internationally recognised carbon labelling methodology, there is a risk that some low-carbon products will not be recognised, and as a result some developing country producers will lose out.

All aid programmes should ensure that any given development programme uses trade efficiently and is consistent with limiting climate change and achieving a sustainable pattern of production. In practice it is already difficult to separate funding for adaptation or mitigation for climate change from funding for normal adaptation to new trading problems or opportunities, and this will become increasingly difficult as standard project analysis increasingly takes account of climate change. That targeted assistance should be additional to normal Official Development Assistance (ODA) does not mean that it should be separate from it at the level of programmes or projects. But any new purpose for Aid for Trade will require additional funding to avoid diversion from existing needs.

There is much scope for climate change finance and existing trade facilitation mechanisms, such as Aid for Trade, to work together to address the challenges of climate change: many of the donors that have provided mitigation and adaptation finance are also involved in trade-related assistance. However, the current absence of standardised checks to ensure compatibility suggests that coordination between institutions and programmes needs to be improved; such coordination may, at the same time, serve to reduce potential conflicts between competing demands and agendas.

The Aid for Trade initiative, like climate change mitigation and adaptation finance, is about the delivery of global public goods. In all these cases, funding must be additional and must not be diverted from other sources. The need to establish and delineate financing mechanisms that can stand alone if necessary becomes even more important in the current environment of donor resource constraint.

INTRODUCTION

Agricultural trade flows depend on the interaction between trade policy and inherent comparative advantage..[5] Not only is the agricultural sector highly vulnerable to climate change, it is also one of the sectors most distorted and heavily influenced by a wide range of local, regional, national and international trade policies. The increased stress to the system brought about by climate change makes reform in global agricultural policies arguably even more important.

Even if the most ambitious climate change mitigation measures are adopted, global temperatures are likely to increase by at least 2^{O} C since pre-industrial levels by the end of this century, if not sooner; the intensity and frequency of extreme climatic conditions are expected to increase and the predictability of normal rainy seasons, decrease.[6] Poor countries with a large rural economy depend on agricultural exports for their fiscal and socio-political stability (Christoplos 2009); climate change could potentially jeopardise agricultural export earnings unless alternatives can be sought or climate proof investments are made.

But what are the alternative sources of export earnings? Given the potential impact of climate change on agricultural production, this document sets out to assess how producers might adapt, particularly in relation to new markets for agricultural products and services related to climate change mitigation efforts. The first section, 'Scoping and Diagnostics', reviews some of the most notable climate change scenarios at the aggregate, as well as the country- and product-specific level (where this is possible). It then sets out to quantify the potential static revenue losses that might result from the effects of climate change on agricultural trade flows, and the resultant impact on employment and GDP, for some of the most vulnerable and poorest countries in the world.

The second section reviews adaptation and mitigation options related to the agricultural sector, in three parts: first, climate change proofing current modes of production; second, diversifying into new products; and third, diversifying into new services. It relates the second and third options to global climate change mitigation efforts. The third section reviews existing mitigation and adaptation finance mechanisms and their subsequent components; it assesses the extent to which available instruments and mechanisms are being leveraged to meet the challenges of climate change for the agricultural sector in vulnerable economies.

The fourth section reviews other sources of finance designed to facilitate trade and access to markets, such as Aid for Trade. It assesses the extent to which existing financial resources might adapt to accentuated development challenges given the impact of climate change on the agricultural sector in poor countries and the e increased demands which may result. The final section concludes with a summary of overall findings and an assessment of how 'new' sources of climate change finance and existing mechanisms and tools could, and should, work together to address the challenges of climate change in the agricultural sector for vulnerable producers and exporters.

1. SCOPING AND DIAGNOSTICS

Although there are uncertainties in relation to the impact of climate change on agricultural production, there are a number of areas where general agreement exists:[7]

- the only certainties about the impact of climate change on agriculture are increasing uncertainty, variability, and frequency and severity of extreme events (storms, hurricanes, droughts, etc.);
- there are opportunities for some countries (e.g. North America, Russia, China), under all but the most extreme scenarios, which lead to an expansion of potential agricultural crop land;

- all scenarios show declining yields in Africa in the long run, but the level and rate of this decline differs amongst scenarios; and
- most scenarios show relatively similar impacts on agriculture in the next one to two decades and predict impacts to be moderate during this period at global and regional scales. Impacts at smaller scales (intra-regional and within countries) may be much more severe but are much harder to predict.

The studies reviewed, which lead us to the aforementioned generalised statements, are complex and a result of assumptions, data availability, and modelling technique. Although a range of General Circulation Models (GCMs) are frequently used, few studies are based on the same model.[8] Most of the scenarios reviewed have either formed part of the Fourth Assessment Report (AR4) of the IPCC (2007) or have drawn on the IPCC Special Report on Emission Scenarios (2000).[9] According to the results of these studies, all regions will experience an increase in temperatures towards the end of the current century; this is accompanied by predicted changes in precipitation (though to a much larger degree in terms of variability). In terms of the aggregate impact on agricultural production, it is clear that a greater divergence between regions in terms of output is likely. That is, for the most part, the more southern and equatorial developing countries are expected to lose in terms of agricultural production, whilst developed countries based in the north are likely to gain.

1.1 Predicted Changes for Agricultural Production Systems Across Regions

Most agricultural producers located in low income and less developed countries are typically operating well below their potential productive capacity. As noted by the FAO (2007) the developing world already contends with chronic food problems. Estimates suggest that this situation could worsen: around 11 percent of arable land in developing countries could be affected by climate change, including a reduction of cereal production in up to 65 countries, and loss of up to 16 percent of GDP in some cases.[10] Tables 1.1 and 1.2 summarise some of the generalisable impacts of a range of climate change scenarios (and models) on agricultural production across regions.[11]

Table 1.1: Estimated Impact of Climate Change on Agricultural Production across Southern Regions

	Sub-Saharan Africa	Latin America	South Asia	South-East Asia
Temperature	Temperatures to increase by 3–7° C by 2080–2099.	Temperatures to increase by 1–7.5° C by 2070–2099.	Temperatures to increase by 2.3–4.5° C by 2070–2099.	Temperatures to increase by 2–3.8° C by 2070–2099.
Precipitation	Precipitation to decrease by up to 30–40% in most parts of southern Africa, but to increase by 7% in tropical and eastern regions by 2080–2099.	Precipitation to change by up to -40% to +12% by 2080.	Precipitation to increase by 10–17% by 2070–2099.	Precipitation to increase by 3–8% by 2070–2099.
Agriculture	Rain-fed cereal (wheat, maize, rice) production to decrease by 12% (net loss) by 2080, with great regional variations.	Overall grain yields to change by between -30% to +5% by 2080. For example, rain-fed wheat production is to decrease by 12–27% by 2080.	Net cereal production to decrease by at least 4–10%. For example, rain-fed wheat production is to decrease by 20–75% by 2080.	Overall cereal production to increase by up to 30%, but rain-fed wheat production is to decrease by 10–95% by 2080.

Note: The wide range of temperature and precipitation reflect the scenarios on which the estimates are based across regions.
Sources: Christensen et al. (2007); IPCC (2007); Ruosteenoja et al. (2003).

Table 1.2: Estimated Impact of Climate Change on Agricultural Production in Northern Regions

	Europe	North America
Temperature	Temperatures to increase by 1–5.5° C by 2070–2099.	Temperatures to increase by 2–5° C by 2080.
Precipitation	Precipitation to change by -30% to +30% by 2071–2100.	Precipitation to change by -20% to +20% by 2080–2099.
Agriculture	Cereal yields to increase in northern Europe, e.g. rain-fed wheat production by 10–30%, and to decrease in southern Europe by 2080. However, there will be a net gain overall.	Yields to increase by 5–20% across the whole continent, though with some regional differences across products such as: corn, rice, sorghum, soybean, wheat, common forages, cotton, and some fruits.

Note: The wide range of temperature and precipitation reflect the scenarios on which the estimates are based across regions.
Sources: Christensen et al. (2007); Giorgi et al. (2004); IPCC (2007).

1.2 What Are The Likely Economic Impacts of Climate Change on the Agricultural Sector?

Country-specific studies on the climate change impacts expected for the agricultural sector in most low income countries are scarce, in part due to a lack of data availability. Where country-specific studies do exist, they typically analyse a limited number of crops and cereals feature most prominently. Although such crops are important in terms of global agricultural trade, reductions in agricultural output and productivity because of climate change will affect more than just cereals. A summary of the ways in which climate change may impact agricultural production is presented in Box 1.1 below.

Box 1.1: Impact of Climate Change on the Agricultural Sector

Climate change can influence agricultural production in a number of ways. One can roughly group the drivers into six categories:

- **Temperature** as it affects plants, animals, pests, and water supplies. For example, temperature alterations directly affect crop growth rates, livestock performance and appetite, pest incidence, and water supplies in soil and reservoirs.
- **Precipitation** as it alters, for example, the water directly available to crops, the drought-stress that crops are placed under, the supply of forage for animals, animal production conditions, irrigation water supplies, aquaculture production conditions, and river flows supporting barge transport.
- **Changes in atmospheric CO_2** as it influences the growth of crop plants and weeds by altering one of the basic inputs for photosynthesis.
- **Extreme events** as they influence production conditions, destroy trees or crops, drown livestock, alter water supplies, and influence waterborne transport and ports.
- **Sea level rise** as it influences the suitability of ports and waterborne transport, inundates producing lands, and may alter aquaculture production conditions.
- **Climate-change-motivated greenhouse gas net-emissions reduction efforts** as they would influence the desirability of production processes and the costs of inputs, plus add new opportunities.

Source: Adapted from McCarl (2007).

As noted by Wheeler and Tiffin (2009:35), within the economic literature on climate change, there are two approaches that can be interpreted as reflecting the net costs of adaptation. These are referred to as the 'Ricardian' and 'crop growth model' methods. The Ricardian model includes the value of land and is modelled under assumptions that reflect the future profitability of land; in the crop growth model, the impacts of climate change are simulated and the value of the resultant change in output taken as a measure of the economic impact of climate change. Cline (2007) provides the results of both approaches across regions and a total of seventy countries.[12]

The recent study by Cline (2007) provides the most comprehensive estimates of aggregate changes in output; it has been used and supplemented by the contribution of the agricultural sector to GDP and employment for the low income and less developed countries included, the results of which are summarised in Table 1.3. Cline's (2007) estimates are based on a consensus set of geographically detailed estimates for changes in temperature and precipitation by the 2080s, which are applied to agricultural impact models.

The results have been further supplemented by agricultural trade data for the most recent five years, as presented in Table 1.4. This has been done with a view to estimating the impact of climate change on agricultural trade flows, in a simple static sense, and to estimating, therefore, the brevity of potential export losses across countries in today's terms. The following sub-sections discuss the results.

1.2.1 Impact on agricultural output

Some of the most dependent agricultural economies face an estimated loss of more than 50 percent of their total agricultural output by 2080, even when including carbon fertilisation effects (where an increased concentration of carbon dioxide in the atmosphere acts as a stimulus to crop productivity).[13] Losses of agricultural output, without carbon fertilisation, range from -5.4 percent to -0.1 percent, as shown by Table 1.3 below. However, even with carbon fertilisation effects, only Kenya seems to gain: an increase of 8.8 percent in agricultural output is estimated by 2080, based on the crops produced and agricultural output as of 2003. For all other countries listed, losses of between -1.9 percent and -54.1 percent in agricultural output are expected by 2080.

Table 1.3: Predicted Changes in Agricultural Production across Countries within Regions

Country	Dependence on Agricultural Sector		Vulnerability to Climate Change			
	Agriculture value added (% of GDP) for nearest year	Employment in agriculture (% of total employment for nearest year)	Agricultural output for 2003		Estimated change by the 2080s in % of agricultural output	
			per ha in 2003 USD	Millions of 2003 USD	Without carbon fertilization	With carbon fertilization
Liberia	66	-	419 (c)	1 833 (c)	-32.7 (c)	-22.6 (c)
Somalia	66		-	-	-16.6 (b)	- 4.1 (b)
Guinea-Bissau	62	-	419 (c)	1 833 (c)	-32.7 (c)	-22.6 (c)
Central African Republic	56	-	478 (a)	1 429 (a)	-60.1 (a)	-54.1 (a)
Ethiopia	47	44.1	253	2 794	-31.3	-20.9
Congo, Democratic Republic of	46	-	422	3 289	-14.7	-1.9
Sierra Leone	46	-	419 (c)	1 833 (c)	-32.7 (c)	-22.6 (c)

Table 1.3: Continued

Tanzania	45	82.1	430	4 634	-24.2	-12.8
Niger	40	-	243	1 092	-34.1	-24.2
Mali	37	41.5	350	1 644	-35.6	-25.9
Afghanistan	36	-	313	2 448	-24.7	-13.4
Malawi	34	-	267	651	-31.3	-21.0
Nepal	34	81.9	728	2 399	-17.3	-4.8
Burkina Faso	33	-	190	1 296	-24.3	-13.0
Uganda	32	69.1	280	2 015	-16.8	-4.3
Cambodia	30	70.2	378	1 438	-27.1	-16.1
Madagascar	28	78	447	1 587	-26.2	-15.1
Mozambique	28	-	253	1 123	-21.7	-10.0
Kenya	27	19	446	2 300	-5.4	8.8
Zambia	22	-	189	997	-39.6	-31
Bangladesh	20	51.7	1 355	11 421	-21.7	-9.9
Viet Nam	20	58.8	969	8 616	-15.1	-2
Zimbabwe	19	-	901	3 018	-37.9	-29
India	18	68.1	777	132 140	-38.1	-28.8
Senegal	16	-	441	1 104	-51.9	-44.7
Guinea	13	-	419 (c)	1833 (c)	-32.7 (c)	-22.6 (c)

Notes: (a) Values refer to Other Equatorial Africa (group of following countries: Republic of the Congo, Gabon, Equatorial Guinea, Central African Republic); (b) Values refer to Other Horn of Africa (group of following countries: Djibouti, Somalia); (c) Values refer to Other Equatorial Africa (group of following countries: Guinea, Guinea Bissau, Liberia, Sierra Leone).
Sources: Cline (2007); World Development Indicators for nearest year.

Table 1.4: Contribution of Agricultural Exports to GDP

Country	Agricultural Exports US$ Million						GDP US$ million (nearest year)	Value of agricultural exports as a % of GDP
	2003	2004	2005	2006	2007	2008		
Malawi	439	380	410	566	769	778	3 164	24.6
Zimbabwe		855	452	1 778	813		3 418	23.8
Kenya	1 284	1 316	1 555	1 841	2 155	2 623	22 779	11.5
Ethiopia (excludes Eritrea)	451	476	812	899	1 029	1 365	13 315	10.3
Viet Nam	2537	3 195	3 990	4 562	6 050		60 999	9.9
Uganda	280	337	386	454	649	798	9 419	8.5
Guinea-Bissau	59	54	23				304	7.5
Mali	403	423	328	345	300	340	5 866	5.8
Mozambique	120	172	215	314	231	367	6 833	5.4
Tanzania, United Republic of	360	422	558	497	634		12 784	5.0
Burkina Faso	286	368	303				6 173	4.9

Table 1.4: Continued

Madagascar	330	224	129	168	220	199	5 499	3.6
Zambia	149	384	318	327	403	326	10 734	3.0
Senegal	185	182	199	133	298	252	9 186	2.7
Niger	82	84	71	80	83	81	3 663	2.2
India	6 617	7 208	9 270	11 524	14 652	19 701	911 813	2.2
Nepal	140						8 938	1.6
Guinea		14	23	79	32	23	3 317	0.7
Bangladesh	51	111	207	204	370		61 897	0.6
Afghanistan						27	8 399	0.3
Cambodia	9	20					7 258	0.3
Central African Republic	2	2	1				1 494	0.1

Note: GDP and exports for nearest year have been used. Agricultural exports are defined as those included under the WTO Agreement on Agriculture. Ethiopia excludes Eritrea.
Source: UNComtrade and World Development Indicators.

As shown by Table 1.4 some countries have experienced rapid growth in their agricultural exports in recent years. Clearly some of the countries that are expected to experience substantial declines in agricultural output because of climate change are also highly dependent on agricultural export earnings as a proportion of GDP. Table 1.5 breaks down the top ten agricultural products and the top three exporters for each, in terms of value and average annual growth rates for the period 2003–08. This shows that, for the countries included, traditional commodities such as 'coffee, tea, maté, and spices' are more important than 'cereals' in terms of their proportion of total agricultural export earnings. Traditional commodity exports such as cotton, tobacco, and sugar and more non-traditional exports, such as cut flowers and ornamental foliage, have also grown at a faster rate (in terms of value) than cereals for the countries included.

Table 1.5: Top Ten Agricultural Product Groups Exported by Sample Countries (Average 2003–08)

Product	Total for sample and top 3 exporters	Average annual export value (US$'000)	Share of average annual exports for top 3 exporters	Share of average annual exports of all agric. items, all countries	Annual average change [a]
Coffee, tea, maté, and spices	All sample countries [b]	4 192	100%	18.5%	8.7%
	Viet Nam	*1 298*	*31%*		*36.5%* [c]
	India	*1 105*	*26%*		*20.9%*
	Kenya	*763*	*18%*		*13.4%*
Cereals	All sample countries [b]	3 552	100%	15.7%	12.8%
	India	*2 236*	*63%*		*22.9%*
	Viet Nam	*1 173*	*33%*		*19.9%* [c]
	Zambia	*32*	*1%*		*50.4%*
Edible fruit and nuts	All sample countries [b]	1 647	100%	7.3%	4.2%
	India	*824*	*50%*		*16.5%*
	Viet Nam	*564*	*34%*		*22.0%* [c]
	Tanzania	*50*	*3%*		*-10.6%* [c]
Cotton	All sample countries [b]	1 642	100%	7.2%	22.4%
	India	*795*	*48%*		*113.1%*
	Mali	*270*	*16%*		*-10.3%*
	Burkina Faso	*256*	*16%*		*4.5%*
Tobacco	All sample countries [b]	1 590	100%	7.0%	14.9%
	India	*379*	*24%*		*24.6%*
	Malawi	*356*	*22%*		*19.1%*
	Zimbabwe	*298*	*19%*		*-18.9%* [d]
Residues and waste from the food industries; prepared animal fodder	All sample countries [b]	1 379	100%	6.1%	41.5%
	India	*1 306*	*95%*		*44.1%*
	Viet Nam	*21*	*2%*		*8.7%* [c]
	Nepal [e]	*11*	*1%*		*n/a*
Edible vegetables	All sample countries [b]	1 319	100%	5.8%	14.0%
	India	*521*	*39%*		*18.2%*
	Kenya	*208*	*16%*		*12.3%*
	Viet Nam	*154*	*12%*		*26.9%* [c]
Sugars and sugar confectionery	All sample countries [b]	992	100%	4.4%	21.8%
	India	*646*	*65%*		*30.3%*
	Malawi	*65*	*7%*		*-13.2%*
	Zambia	*61*	*6%*		*14.1%*
Oil seeds and oleaginous fruits	All sample countries [b]	935	100%	4.1%	19.9%
	India	*571*	*61%*		*24.8%*
	Ethiopia	*157*	*17%*		*33.2%*
	Viet Nam	*63*	*7%*		*3.7%* [c]

Table 1.5: Continued

Live trees and other plants; cut flowers and ornamental foliage	All sample countries [b]	834	100%	3.7%	21.6%
	Kenya	*361*	*43%*		*21.4%*
	Zimbabwe	*256*	*31%*		*110.6%* [d]
	India	*79*	*9%*		*13.0%*
Total		**18 081**		**79.7%**	

Notes:

(a) 2003–08 unless otherwise noted. It should be noted that the aggregate growth rate for all sample countries shown is distorted by the fact that fewer of the sample countries have reported their trade for 2008 than have for 2003 (13 compared with 19).

(b) All values are as reported by the sample countries themselves to the UN's Comtrade database. The number of years in the period 2003–08 in which countries have reported varies greatly: from one (Afghanistan and Nepal 2008 and 2003 respectively) to all six (Ethiopia, India, Kenya, Madagascar, Malawi, Mali, Mozambique, Niger, Senegal, Uganda, Zambia). The totals from which the shares in the fourth and fifth columns are derived are simple averages of the values reported by all sample countries: for the specific item concerned (Col. 4) and for all items covered by the WTO Agreement on Agriculture (Col. 5).

(c) 2003–07.

(d) 2004–07.

(e) Nepal's exports are based on one year only (2003).

Based on the estimates of Cline (2007) of the impact of climate change on total agricultural output, Table 1.6 estimates some of the static export revenue losses which may result for the countries included in Table 1.4. Those countries that have a high dependence on agricultural output as a proportion of GDP, and for which agricultural exports account for a high proportion of total agricultural output, are clearly the most vulnerable to climate change.

Table 1.6: Estimated Export Revenue Losses by 2080

Country	Agricultural output in 2003, US$ million	Agricultural exports in 2003, or nearest year, US$ million	Agricultural exports as a % of total agricultural output (a)	Vulnerability to climate change: Estimates by the 2080s in % of agricultural exports (b)	
				Without carbon fertilization	With carbon fertilization
Malawi	651	439	67.5	-20.9	-14.2
Zimbabwe	3 018	855	28.3	-10.7	-8.1
Senegal	1 104	185	16.8	-8.7	-7.5
Mali	1 644	403	24.5	-8.7	-6.3
Burkina Faso	1 296	286	22.0	-5.4	-5.4
Zambia	997	149	15.0	-5.9	-4.6
Ethiopia	2 794	451	16.1	-5.0	-3.4
Guinea-Bissau	1 833	59	14.0	-4.6	-3.2
Madagascar	1 587	330	20.8	-5.4	-3.1
Niger	1 092	82	7.5	-2.6	-1.8
India	132 140	6 617	5.0	-1.9	-1.4
Mozambique	1 123	120	10.7	-2.3	-1.1
Tanzania	4 634	360	7.8	-1.9	-1.0
Viet Nam	8 616	2 537	29.4	-4.4	-0.7
Nepal	2 399	140	5.9	-1.0	-0.3
Guinea	1 833	14	0.8	-0.2	-0.2
Cambodia	1 438	9	0.6	-0.2	-0.2
Afghanistan	2 448	27	1.1	-0.3	-0.1

Table 1.6: Continued

Bangladesh	11 421	51	0.4	-0.1	-0.1
Central African Republic	1 429	2	0.1	-0.1	-0.1
Kenya	2 300	1 284	55.8	-3.0	4.9

Note: (a) Calculated based on agricultural output and export values; (b) calculated based on agricultural output and export values as of 2003. Ethiopia excludes Eritrea.
Source: Cline (2007); UN Comtrade.

Countries such as Malawi may need to adapt to a 20 percent reduction in agricultural export earnings because of reduced agricultural output (an estimated 31 percent reduction) as a result of climate change (excluding carbon fertilisation effects); countries such as Mali and Senegal may need to adapt to a reduction of around 10 percent in their agricultural export earnings. Although rudimentary, such estimates may be grossly underestimated given population growth, which may also result in a further reduction of agricultural output (surplus) sold onto international markets.

2. WHAT ARE THE ADAPTATION AND MITIGATION OPTIONS?

The previous section made reference to specific low income country exporters and the potential impact of climate change on agricultural production and trade. This section discusses adaptation and mitigation options that relate to the agricultural sector in much broader terms. The objective is to contrast the opportunity costs of inaction, which are largely underestimated, with available adaptation and mitigation options, within three broad categories:[14]

- 'climate change proofing' existing products and methods of production;
- diversifying into new products and methods of production; and
- diversifying into new tradable services.

The ensuing section links the adaptation and mitigation options identified to specific financial tools and mechanisms included in the (growing) international architecture of climate change finance.

2.1 Climate Change Proofing Existing Products and Methods of Production and Logistics

According to Wheeler and Tiffin (2009:38), the estimate of McCarl (2007) is the only global estimate of the costs of adaptation for the agricultural sector. The correspondence between the results of Cline (2007) and those found by McCarl (2007) is limited, because the former study covers crop production, whilst the latter includes crop production plus forestry and fisheries. Table 2.1 below summarises the UNFCCC's estimates (based on McCarl [2007]) of the costs of adaptation across sectors, including agriculture.[15]

Table 2.1 UNFCCC Estimates of Global Investment Costs for Adaptation

Sector	Global cost (US$ bn per annum)	Of which, developed countries	Of which, developing countries	Residual damage
Agriculture	14	7	7	-
Water	11	2	9	-
Human health	5	0	5	-
Coastal zones	11	7	4	1.5
Infrastructure	8–130	6–88	2–41	-
Total	49–171	22–105	27–66	1.5

Source: UNFCCC (2007) as presented by Wheeler and Tiffin (2009)

The costs of adaptation in the agricultural sector referred to by the UNFCCC (2007) and McCarl (2007) relate to climate change proofing investments, including:

- 10 percent increase in research and extension funding; and
- 2 percent increase in capital investment costs.

The estimates refer to three distinct cost items: better extension services at the farm level; the cost of additional global research (e.g. on new cultivars); and extra capital investment at the farm level (Wheeler and Tiffin 2009). All of the cost items identified relate to increasing agricultural productivity and enhancing resilience to climate change. The estimates are, however, 'top down' and based on the increments that should be made to current expenditure.[16]

An increase in capital investment costs could relate to an increase in irrigation demands. An increase in research and extension expenditure could relate to the development of new crop varieties and plant breeding and/or the provision of inputs such as fertiliser as well as technical assistance related to crop management techniques. Some of the major classes of adaptation in the agricultural sector are summarised in Box 2.1 below. Box 2.2 discusses some of the challenges of adapting to increasing vulnerability because of climate change, in Mali.

Box 2.1: Adaptation Measures in the Agricultural sector

Long-term adaptation measures may include: changes in land use to maximise yield under new conditions; application of new technologies; new land management techniques; and water-use efficiency techniques. Reilly and Schummelpfenning (1999) define the following 'major classes' of adaptation, which include adapting to: seasonal changes and changing sowing dates and different varieties or species. Actions required may include those related to:

- water supply and irrigation systems;
- other inputs (fertiliser, tillage methods, grain drying, and other field operations);
- new crop varieties;
- forest fire management and/or other natural disasters.

Source: UNFCCC (2007)

Given the diversity of possible management responses to the challenges posed by climate change, some authors question whether it is possible to summarise costs in headline figures. However, the UNFCCC estimates do provide a starting point to focus debate, despite the criticisms levied at the estimates as having a limited and mostly speculative basis. Wheeler and Tiffin's (2009) critical review of the UNFCCC estimates concluded that the estimates provide a sufficient overall first approximation. The estimates are considered 'sufficient', in part, because of the limited availability of 'bottom-up' case studies that could better indicate the magnitude of costs. As more specific studies and adaptation options become available, cost estimates are likely to increase.

In sum, around 10 percent of the total costs of adaptation to climate change identified by the UNFCCC (2007)—assuming the top end of adaptation costs—should be destined for the agricultural sector in developing countries. At present, however, both the total proportion of climate change funds for adaptation and their destination (in terms of country, sector, and project) remain largely unclear (as will be further discussed in Section 3).

Box 2.2: Adapting to Climate Change in Mali

Mali is a country in Sahelian Africa where 80 percent of the population lives on agriculture and pastoral activities. The major crops produced for domestic consumption include: millet, sorghum, rice, maize, and legumes. Cotton, vegetables, and tubers are produced as cash crops. Exported agricultural goods include cotton, livestock, mangoes, and fish. Livestock and fisheries are traded, but also serve as a source of wealth. Agricultural activities are likely to be severely affected by climate change, namely through increased temperatures and likelihood of drought, as a result of reduced rainfall, and because of a shrinking rainfall season. These changes in turn affect agricultural and livestock productivity, food security, and food prices, and render agricultural production a daily struggle.

Climate change will limit the quantities and qualities of tradable agricultural goods by reducing cultivated and grazing areas and their productivity, enhancing pest attacks, and limiting access to water. The combination of climate effects is likely to increase the costs of imported goods and limit the market for exported crops, because of a reduction of agricultural surplus.

The climate-induced shrinking of farming and grazing lands may enhance the potential for conflicts between farmers and pastoralists and result in additional pressure on natural resources. Although the Sahelian population has a long history of adapting to climate variability through changes in livelihood strategies (cropping patterns, consumption habits, as well as migration), the adaptation options that farmers can afford (such as new seed varieties and changes in production methods) still depend, to some extent, on rainfall distribution. Farmers are not equipped to adapt to the potential impacts of global climate change; options are limited because all production systems are climate dependant and interdependent.

To cope with climatic changes, some farmers have adopted early maturing and drought resistant varieties, as well as soil water conservation techniques and the application of fertilizer and chemical sprays. But some of these strategies may further limit access to foreign markets because farmers cannot afford 'best agricultural practices' and therefore escape trade barriers. Traceability of exported products requires knowing safety and grading procedures, knowledge that is lacking for most African farmers.

The main objective of agricultural production is self-sufficiency, which is, in practice, rarely achieved by producers in the country. Most public investment in agriculture (around 14.2 percent of the National Budget) targets irrigation development, cereal stocks, and the facilitation of access to credit. A few parts are devoted to research and extension of improved strategies to cope with climate change. The country has a National Action Plan of Adaptation, which has been drafted and submitted to UNFCCC.

Source: Alpha Kergna, Agricultural Economist, Institut D'Economie Rural (IER), Mali

2.2 Diversifying into New Products, Methods of Production

Beyond 'climate proofing' existing modes of production and investment, other adaptation options may include those related to the transition to a low-carbon global economy, which demands new products and services. Developing countries need to adapt to the new market opportunities that arise from efforts to mitigate climate change, as well as to climate change itself. Indeed, the two efforts are related: tapping into new market opportunities effectively could release additional resources for productive investments required to increase resilience to climate change and adapt to its effects. This sub-section reviews some of the

products that are being increasingly demanded as part of this transition.

2.2.1 Trade in carbon

Out of the total greenhouse gas (GHG) abatement opportunities and mitigation measures identified by McKinsey (2009), that need to be undertaken and adopted in order to avoid dangerous climate change,[17] 70 percent are located in the developing world (non-Annex 1 countries).[18] The carbon abatement opportunities identified by McKinsey (2009) fall within (and across) the following categories: energy efficiency, terrestrial carbon, and low-carbon energy supply. Around 30 percent of the total GHG abatement opportunities identified fall within the terrestrial carbon category. This relates to both forestry and the agricultural sector and includes: halting deforestation, reforesting marginal areas of land, and sequestering more 'carbon' (or 'carbon equivalent', CO_2e) in soils by changing agricultural practices. Of the total amount of terrestrial carbon abatement opportunities identified by McKinsey, 90 percent are located in the developing world. Table 2.2 provides a summary of the terrestrial carbon abatement opportunities identified.

Table 2.2: Terrestrial Carbon Abatement Opportunities in the Agricultural Sector

Sub-categories Identified as Terrestrial Carbon
Crop nutrient management
Rice management
Reduced slash and burn agriculture
Reduced pastureland conversion
Reduced intensive agriculture conversion
Pastureland afforestation
Grassland management
Organic soil restoration

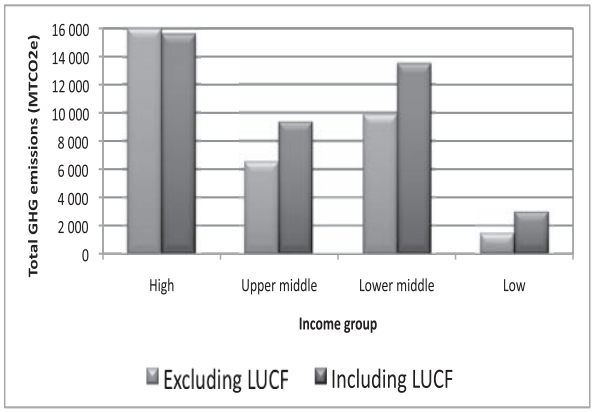
Source: Adapted from McKinsey (2009)

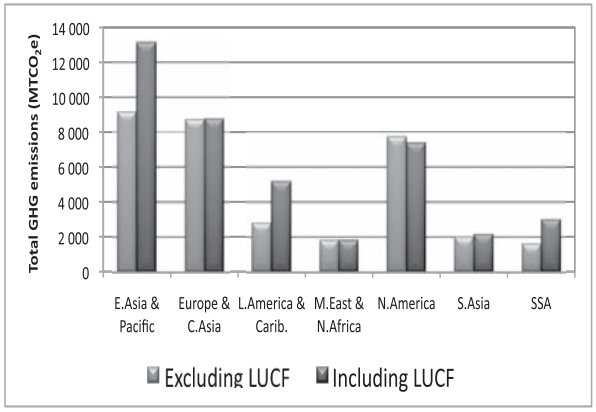
Since most low income countries are already 'low carbon', any international agreement is likely to exclude them from binding emissions reductions targets, but include the opportunity for them to sell their certified emissions reductions. The Clean Development Mechanism (CDM) is one of the key tools established as part of the Kyoto protocol designed to encourage trade in certified emissions reductions between the developed and the developing worlds—that is between those countries that have legally binding emissions reductions targets and those that do not.

There is a one percent cap on the share of carbon credits that can be generated through Land Use Changes and Forestry (LUCF) within the current commitment period of Kyoto (2008–2012); some researchers have argued that if the CDM included all terrestrial carbon opportunities it could lead to a collapse in the price of carbon (UNDP 2008). However, it is highly likely that avoided deforestation (Reduced Emissions from Deforestation and Forest Degradation, abbreviated to REDD) will be included in the next commitment period, despite these fears.[19]

There is much more uncertainty about other types of terrestrial carbon. But recognition of *all* types of terrestrial carbon could offer primarily agriculturally based societies, such as low income countries, potential new market opportunities in carbon trade and, therefore, sources of income. Figures 2.1 and 2.2 present the share of emissions generated by Land Use Change and Forestry (LUCF) across countries and regions; almost half of sub-Saharan Africa's emissions are from LUCF.

Figure 2.1 and 2.2: Total CO_2e Emissions by Income Group and Region (2000); Including and Excluding Land Use Change and Forestry (LUCF)





Source: Derived from data obtained from World Bank (2009b) and WRI (2009). World Bank income groups as of July 2009. Taiwan (not included in the World Bank listing) has been assumed to be high income. 2000 is the latest year for which LUCF data are available.
(a) 2000 is the latest year for which LUCF data are available. Includes data from international bunkers (where available).
Note: Annex Table 2 presents those countries that have been excluded from analysis because of a lack of data.

The IPCC (2007a) notes that the mitigation potential of the agricultural sector could be significant. Expanding the scope of carbon markets to include agricultural soil carbon would mean allowing carbon finance to play more of a role in promoting sound land management practices. This view is echoed by the UNDP (2008) as summarised in Box 2.3 below.

Box 2.3: GHG Mitigation through Carbon Sequestration in Soils

Abatement opportunities in agriculture arise from improved crop land nutrient management, reduced slash and burn agriculture, less intensive agricultural production (i.e. less use of chemicals, fertilisers, and pesticides produced from energy intensive processes), pastureland afforestation, and degraded-land restoration, in addition to improved livestock management (as methane released from livestock is also a GHG). The environmental degradation of soils is both a cause and effect of poverty. Tapping into carbon markets to profit from these abatement opportunities could unlock multiple benefits. These include an increased flow of finance into environmental sustainability, support for more resilient livelihood systems in the face of climate change, and benefits for climate change mitigation.

Source: Adapted from UNDP (2008).

The limited participation of sub-Saharan Africa in the first commitment period of the CDM is to some extent to be expected: large developing country emitters, such as China, have benefited the most from the CDM to date because they emit more and therefore have emissions ready to be offset.[20] However, recognition of avoided emissions in both the forestry *and* agricultural sector within the CDM may, in the future, increase the level of participation of low income and primarily agricultural societies.[21]

Many issues surrounding monitoring and verifying the increased storage capacity and permanence of carbon sequestration remain to be resolved. Should they be resolved, it may become increasingly attractive to invest in the agricultural sector in non-Annex 1 countries and to offset emissions produced elsewhere. As noted by the World Bank (2009, chapter 3:42): "a soil compliance carbon market holds great potential for achieving the necessary balance between intensifying productivity, protecting

natural resources, and simultaneously helping rural development in some of the world's poorest communities."

However, such a market is not yet ready: technical issues regarding verification, scale, and time frame remain to be resolved. The second commitment period of the Kyoto protocol and the CDM (2012–2016) is unlikely to include all terrestrial carbon opportunities. However, other regional, national, or voluntary carbon markets may be more accommodating in the future (see Box 2.4 and Annex Figure 1).

Box 2.4: Carbon Trading Regimes

Until developing countries are ready (authors such as Stern [2008] put this date at around 2020) a 'one sided' trading regime is proposed, which rewards developing countries for reducing emissions, but does not punish them for failing to do so. During this period, developing countries should commit to strong sectoral reductions supported by international financial institutions and carbon markets; this means moving CDM from being project-based to operating at a more sectoral level (See ODI, 2008c). The EC (2009) proposes that for advanced developing countries and highly competitive economic sectors, the CDM should be phased out, with a move to a 'cap and trade' system, possibly via a sectoral carbon market mechanism. The proliferation of cap and trade schemes across countries and possibly regions may result in increased opportunities for some types of terrestrial carbon mitigation. Although the institutional and legal framework of the global carbon market—in which the CDM plays a crucial role—is set out by the UNFCCC, individual companies may prefer to use voluntary carbon markets and standards, some of which include the agricultural sector.

The importance of terrestrial carbon has recently been recognised by the US. The Waxman-Markley Act was passed by the House Energy and Commerce Committee on 21 May 2009 and the House of Representatives on 28 June 2009.[22] The bill includes binding emissions reductions targets from major US sources of 17 percent by 2020 and 80 percent by 2050, compared to 2005 levels. It mandates energy saving standards for buildings, appliances, and industry. And it requires that 20 percent of electricity demand be met through renewable energy sources and energy efficiency by 2020. It also includes agricultural credits based on the sequestration of carbon in soils.[23] And, perhaps more controversially, it provides for the application of Border Tax Adjustments (BTAs) on those countries that don't adhere to emissions reductions targets.

The EC has also recognised the role the agricultural sector has to play in the mitigation of climate change and has proposed to review key sectoral policies by 2012 to determine the potential impacts and costs of climate change for different economic sectors.[24] In sum, despite the fears of a collapse in the price of carbon in international carbon markets should the agricultural sector be included in carbon trading schemes, this has not prevented other national schemes from recognising the importance of the sector and the role it must play in mitigating climate change.

2.2.2 Low-carbon products

There is no approved CDM methodology for verifying GHG emissions offset by biofuels, since land may have been cleared to produce the biofuel crop (ODI 2008a). However, the EC has proposed legislation that includes mandatory requirements for measuring the carbon footprint of biofuels. This is to ensure that only certified biofuels which meet environmental sustainability criteria are used to fulfil national renewable energy targets. The sustainability criteria require that the GHG emission saving from the use of biofuels and other bioliquids must be at least 35 percent, applicable from 1 April 2013 (EC 2008).[25]

This is part of a predicted trend in the transition to a low-carbon global economy: the required certification of low-carbon products as such.[26]

If certification is undertaken using lifecycle analysis, which is the more objective, but inevitably more costly, methodology, some developing country agricultural exporters may benefit from the relocation of agricultural production from high- to low-emitting locations. This may also be the case for other types of sectors and industry, such as manufacturing. What's known as 'carbon leakage' occurs when stringent emissions-reductions targets cause production to relocate to countries without such regulation. BTAs are designed to reduce the likelihood of 'carbon leakage'. The implementation of such measures requires an understanding of the carbon content of products.

Box 2.5: Approaches to Carbon Labelling

- **Lifecycle approach:** This methodology includes adding up all carbon emissions throughout a product's life from the production of inputs to final consumption and disposal of waste. As noted by Brenton et al. (2008), the methodological difficulties of turning this intuitively appealing idea into practice are immense and the lack of standardised methods heavily influences the usefulness and comparability of existing studies. However, this is the scientifically preferred measure.
- **Carbon footprint estimates (carbon disclosure):** This methodology includes estimating GHG emissions related to production and final consumption, but excludes the additional carbon emissions related to inputs. The approach therefore traces the value chain, from farming to pack-house, transportation, and sale (including storage and packing).
- **Transportation approach, 'food miles':** This methodology estimates the carbon footprint of a product based only on the emissions that result from transportation.

Brenton et al. (2008) note that the effective inclusion of low income countries in carbon labelling schemes may offer important opportunities for global emissions reductions; this is because doing so may incentivise increased trade with such countries because of their favourable climatic conditions and use of low energy-intensive production techniques. As Table 2.3 shows Kenya is a considerably more carbon-efficient production location for cut flowers than the Netherlands, even if the emissions associated with air freight are included.[27] Kenya is also a country identified by Cline (2007) as potentially experiencing an increase in agricultural production as a result of climate change—assuming carbon fertilisation effects (see Table 1.3).

Table 2.3: GHG Emissions Comparison—Cut Flowers from Kenya and the Netherlands

Supply chain section	Kenya	Netherlands
Production	300	36 900
Packaging	110	160
Transport to airport	18	0
Transport to distribution centre	5600	0
Transport to distribution centre from airport	5.9	50
	6 034	37 110

Source: Adapted from Edwards-Jones at al. (2008) with reference to Williams (2007).
Note: Emissions are shown as Global Warming Potential (GWP) expressed in kg of CO_2 equivalents using the IPCC (2001) conversion factors. GWP and CO_2 emissions from Kenya include the IPCC altitude factor.

A well-designed labelling scheme would not penalise developing country exporters unable to cover costs of compliance. Such a scheme could incentivise increased production of low-carbon products in countries that are more carbon efficient. These may include low-carbon and clean energy products such as first generation biofuels. Despite the public perception of biofuels production as competing with food crops, developing country households typically grow both food and biofuels; increased biofuel production could provide a stimulus to agricultural productivity.[28]

However, without a well-designed and approved carbon labelling and/or 'sustainability' methodology, there is a risk that some low-carbon products, including some types of first-generation biofuel, would not be not recognised. This may have negative implications for some producers in developing countries. Developing countries would be negatively impacted, for example, if carbon labelling proceeded along less objective lines, such as calculation of emissions from method of transportation only or if producers are unable to prove compliance even though they meet low-carbon criteria.[29]

2.3 Diversifying into New Tradable Services

New tradable services will be needed in the transition towards a low-carbon global economy. As noted by UNCTAD (2009) the complexities involved in conducting, monitoring, verifying, and enforcing CDM projects, for example, allow considerable margin for the market development of various service activities, including engineering, environmental, legal, and verification services.[30] New types of institutional infrastructure will also be required to support trade in carbon, low-carbon products, and trade in general in a carbon-constrained world.

The development of such new services could be developed in parallel with those that already exist, such as tourism, air freight, and shipping. The constraints to such development are likely to be similar to those that limit growth in other, more traditional, tradable services; however, recent literature suggests that economic diversification is best achieved by targeting new products and services that are 'close' to those already being produced and used (Hidalgo et al. 2007).

There is scope to increase revenues from mitigation policies aimed at existing services. The World Bank in its latest World Development Report 2010 estimates that Least Developed Countries could gain as much as US$4–10 billion from a levy on international air travel (IATAL) and around US$4–15 billion from levies on bunker fuels (IMERS).[31] The report notes that the international nature of such sectors may make a tax more palatable to national finance ministers and that the tax base would be large enough to raise considerable amounts.

Carbon taxes, such as levies on air travel or bunker fuels, in comparison to cap and trade schemes, are direct sources of fiscal revenue;[32] governments can choose to use this revenue to finance expenditure or to lower or eliminate other taxes.[33] However, carbon taxes levied on producers are considered much more unpalatable to business, compared to cap and trade schemes. For example, the aviation industry is currently working under the industry coalition of the Aviation Global Deal Group (AGD) to establish a sectoral cap and trade agreement, considered by this business sector to be more flexible and accommodating to their needs. The revenue from this agreement would be used to support adaptation and mitigation efforts in developing countries. Whether taxes or cap and trade schemes are utilised, additional sources of revenue are likely to be forthcoming, and new services such as the monitoring and verification of emissions, will be required in order to capitalise on such new opportunities.

3. WHAT ARE THE AVAILABLE RESOURCES TO ASSIST ADAPTATION AND MITIGATION RELATED TO THE AGRICULTURAL SECTOR?

Although the international architecture for financing climate change mitigation and adaptation is new and growing, there is a considerable gap between identified needs and current pledges. There is also considerable variation in terms of the focus of funds. The following sections attempt to identify the proportion of international climate change finance destined for the agricultural sector in developing countries (loosely defined as those countries which are not currently required to adhere to binding emissions targets).

3.1 Finance for Mitigation

There are a variety of financial resources available to fund climate change mitigation efforts. These include: 1. carbon markets and the Clean Development Mechanism (CDM); 2. private investment; 3. international public funds; 4. national public funds; 5. private philanthropy; and 6. innovative financial mechanisms. The resources allocated to each are based on various emissions reduction scenarios and mitigating actions and are summarised in Table 3.1 below. Further details on international public funds, and their respective components in relation to the agricultural sector, can be found in Annex Table 5.[34]

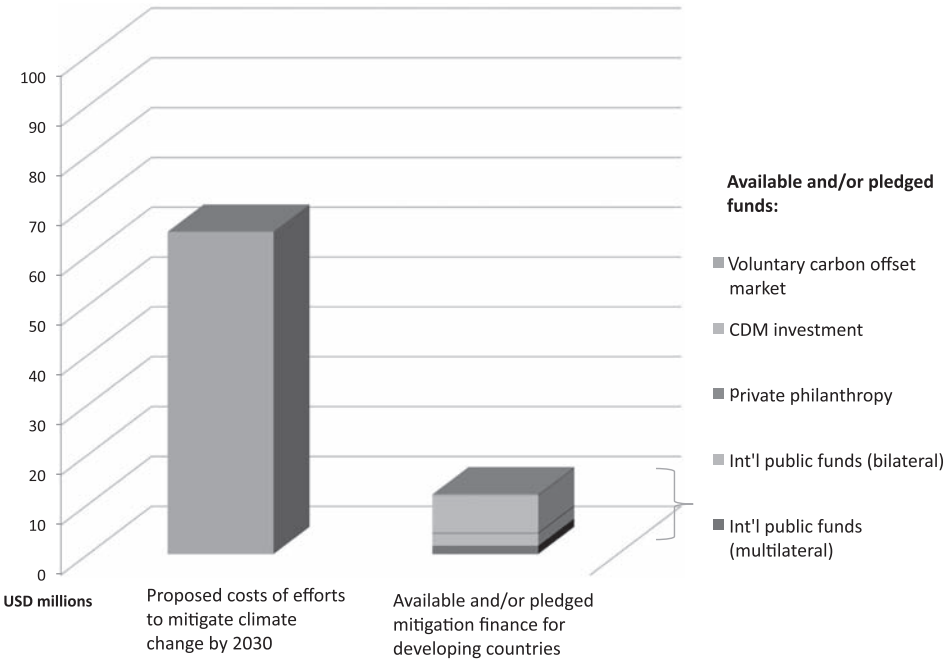
Table 3.1: Pledged and Proposed Funds for Mitigation in Developing Countries

	Amount per annum (US$ Bn)	Source
Projected costs of mitigation		
Projected costs of mitigation (between 2010–2020)	71–103	McKinsey (2009)
Pledged mitigation finance (2008–2012)		
International public funds (multilateral)	1.68	www.climatefundsupdate.org
International public funds (bilateral)	2.46	www.climatefundsupdate.org
Private philanthropy	0.2	Design to Win (2007)
CDM investment	7.4	Capoor & Ambrosi (2008)
Voluntary carbon offset market	0.27	Capoor & Ambrosi (2008)
Proposed future mitigation finance (2012 and beyond)		
Proposed innovative financing mechanisms	Ranges up to 201	Brown (2008)

Note: As of March 2009

Despite the amounts of mitigation finance pledged, the pledged money remains considerably lower than the estimated costs, as illustrated by Figure 3.1. As can also be seen, and as noted by the World Bank (2009a), the financial revenues the CDM generates are modest relative to the amount of mitigation money that will have to be raised. But they constitute the largest source of mitigation finance to developing countries to date.

Figure 3.1: Mitigation Finance Required by Developing Countries per Annum Compared to That Available



Sources: www.climatefundsupdate.org, World Bank, http://greengrants.org/pdf/design_to_win.pdf
Note: McKinsey (2009) costs of mitigation have been used; estimates as of March 2009.

3.2 Finance for Adaptation

Currently, there are two dedicated adaptation funds under the UNFCCC, which are managed by the Global Environmental Facility (GEF); the Least Developed Countries Fund (LDCF); and the Special Climate Change Fund (SCCF). A third fund for adaptation has also recently been established under the organisation of the GEF: this is called the Special Priority on Adaptation (SPA) and is essentially a GEF trust fund.[35] The LDCF supports the preparation and implementation of National Adaptation Plans of Action (NAPAs).

NAPAs focus on enhancing adaptive capacity to climate variability. They provide a process for LDCs to identify priority activities that respond to their urgent and immediate needs with regard to adaptation to climate change. The SCCF focuses on climate change mitigation measures that are integrated into national poverty reduction strategies. The SPA finances adaptation activities that also generate global environmental benefits.

To date, adaptation funds disbursed translate to only around US$250 million a year to poor countries for climate change projects. Nearly one-third of the US$760 million distributed in the last three years has gone to China, India, and Brazil and less than US$100 million of the total has gone to projects in the world's 49 poorest countries. The Least Developed Countries Fund (LCDF) has only financed 22 projects, together worth US$50 million.[36]

3.3 International Funds for Mitigation and Adaptation Targeted at the Agricultural Sector

Although there has been much criticism of both the amount of mitigation and adaptation funds disbursed to date as well as which countries have received these funds, Annex Table 5 attempts to identify, in broad terms, the proportion destined for the agricultural sector. This has been achieved by reviewing the projects currently in receipt of both types of funds (adaptation and mitigation). Funds targeted at adaptation in the agricultural sector appear to be more prevalent than those for mitigation efforts, such as diversifying into new low-carbon products. Clearly the GEF Least Developed Countries Fund has been the most active fund in the agricultural sector to date in relation to both adaptation and mitigation efforts.

3.4 National Adaptation Plans of Action (NAPAs)

Specific interventions planned for the agricultural sector, designed to help some of the countries most vulnerable to climate change, are summarised in Annex Table 6. Essentially, these are country-specific 'bottom-up' estimates of the likely costs of adaptation to climate change; in all cases they refer to the costs required to 'climate change proof' existing modes of agricultural production. The difficulties in distinguishing between funds for adaptation to climate change in the agricultural sector compared to 'normal' development practices are clear.

Annex Table 6 also identifies the proportion of adaptation funds in the current NAPA that is destined for the agricultural sector. If we reflect back on the most vulnerable economies identified in Section 1, in terms of the contribution of agricultural output and exports to GDP, we can see that in some cases the proportion of total funds allocated to the agricultural sector appears to support the identified degree of vulnerability (i.e. Malawi). However, in some cases, this does not appear to be the case, i.e. Senegal.[37] And in other cases, NAPAs are simply not yet available, including some of the most vulnerable countries identified (i.e. Mali).

If the costs identified in all NAPAs were totalled, they should approximate to the estimates of the UNFCCC (2007) required to 'climate change proof' the agricultural sector globally. This is true regardless of differences between countries, both in terms of the proportion of NAPA funding destined for the agricultural sector as well as overall vulnerability to climate change. The costs that wouldn't be reflected are those that relate to adaptation to new market opportunities and sources of income.

It is highly likely that developing countries will need to make available country-specific information on their carbon budgets, as well as options to reduce their emissions, in order to access some types of climate change finance for mitigation (and to a lesser extent adaptation). Although there are new market opportunities associated with low-carbon growth and global mitigation efforts, there are also some major barriers. These include a dearth of scientific capabilities to verify emissions reductions: tapping into carbon markets effectively requires a new type of institutional trade infrastructure. The following section reviews other sources of finance designed to facilitate trade and access to markets, such as Aid for Trade.

4. LINKING AID FOR TRADE TO CLIMATE CHANGE AND AGRICULTURE

Technical assistance for trade aims to help developing countries design and implement trade policy effectively and to help producers within these countries be competitive, given the policies, markets, products, and conditions which face them, now and in the future. While good technical support programmes should implicitly prepare countries to meet any expected trading environment (as well as the actual trading environment), some changes affecting international trade may be so large or so uncertain that trade assistance must allow for them explicitly. Climate change and the international conventions in response to this will affect what is produced, what is traded, trading rules, the standards traded goods must meet, and the regulations that they must follow.

As discussed in Section 1, this creates new costs and new opportunities, and therefore new needs for assistance related to trade. An additional reason for linking trade-related aid to climate change is that in some cases the new international climate change agreements are linked to financing for the costs of adaptation or mitigation. To the extent that these costs are related to trade, this financing must be coordinated with general assistance for trade. Changes in the climate, and in agreements about it, can thus affect the demand for and the supply of financing for trade capacity building.

This section will first look at how Aid for Trade has emerged as an agreed-upon international initiative, because this offers possible lessons for aid for climate change. It will then examine the specific categories of Aid for Trade to indicate how they could be related to needs for assistance that are arising out of climate change. It will finally look at the problems of coordinating different types of assistance.

4.1 The History of Aid for Trade in the World Trade Organization

The costs of trading became an important issue in the Doha Round of WTO negotiations because developing countries were still facing costs from implementing the agreements of the previous Uruguay Round, and they feared that the new Doha Round would impose additional costs—both in terms of negotiating capital as well as direct fiscal impacts. Both of these additional costs have clear parallels with concerns about the economic impact of climate change through new rules and through damage to production.

The extension of trade rules to new areas like intellectual property and the tightening of rules on existing areas have led to complaints that these rules had high costs of compliance for developing countries, often out of proportion to any benefit. While there had been general statements in previous agreements about potential technical assistance to help countries meet these costs, there had been no formal commitments and countries did not consider that the aid had been sufficient. Therefore they would not accept new obligations without guaranteed assistance to meet the costs. The second main concern of developing countries in the Doha Round was about preference erosion. Those countries that already had exceptionally favourable preferential access feared that multilateral liberalisation would reduce their export revenue. Starting in 2003, developing countries began suggesting special funding as a necessary part of any trade agreement.

The first result, in 2004, was a way of dealing with regulatory costs. For the proposed new rules on Trade Facilitation (how goods are treated at the border), it was agreed that countries that did not receive the 'required support and assistance' would not be bound to implement the new rules. In order to deal with the much higher potential real costs from loss of exports, WTO members adopted a clause mandating Aid for Trade (Hong Kong Ministerial Declaration, paragraph 57, WTO 2005),

"to build the supply-side capacity and trade-related infrastructure that they [developing countries] need to assist them to implement and benefit from WTO Agreements and more broadly to expand their trade". They set up a Task Force to report within six months, and the report was adopted in 2006.

The Task Force (WTO 2006) defined the scope of Aid for Trade as:

- Trade policy and regulations, including: training of trade officials, analysis of proposals and positions and their impact, support for national stakeholders to articulate commercial interest and identify trade-offs, dispute issues, institutional and technical support to facilitate implementation of trade agreements and to adapt to and comply with rules and standards.

- Trade development, including: investment promotion, analysis and institutional support for trade in services, business support services and institutions, public-private sector networking, e-commerce, trade finance, trade promotion, market analysis and development.

- Trade-related infrastructure, including: physical infrastructure

- Building productive capacity.

- Trade-related adjustment, including: supporting developing countries to put in place accompanying measures that assist them to benefit from liberalised trade.

- Other trade-related needs.

The success (and speed) in securing agreement to special provisions to fund Aid for Trade was, in large part, due to the desire to secure a multilateral trade agreement that required the consent of all countries. It was consistent with the view that the developed countries that had created the system of preferences should help to meet the costs of unwinding it. But it also owed some of its acceptability to dissatisfaction with the treatment of aid in existing aid programmes. The increased focus on poverty reduction goals was often interpreted as requiring recipients to change allocations in favour of social programmes rather than support for the productive sectors. Aid to improve capacity to trade had fallen as a proportion of total aid. Tying demands for additional assistance to negotiating a multilateral agreement, to principles of restorative justice,[38] and also to a real need to reform aid programmes could strengthen arguments for aid to help agriculture adjust to climate change.

The WTO has established a system of reviewing and monitoring progress, based on an annual Global Review. The WTO monitors data collected by the OECD-DAC's Creditor Reporting System (CRS) for all aid. The CRS codes most closely related to the Task Force categories of Aid for Trade were identified and agreed upon with the WTO, and are used by the OECD to report to the WTO on donors' aggregate funding of Aid for Trade.

In addition to compiling data, the OECD and WTO jointly issued questionnaires in 2007 and 2008 to bilateral donors, recipient countries, and some international agencies asking for information on their Aid for Trade strategies and what they fund or receive. Some information going beyond flows of funds data is thus now available at world and country level. The WTO also includes monitoring Aid for Trade in its Trade Policy Reviews of both donor and recipient countries. As these take place only every two years for the major donors and, at most, every six years for the poorest countries, this process will take time to cover all countries.

The data from the CRS, the Global Review by the General Council of the WTO, and the detailed monitoring of donors and recipients through the questionnaires and potentially in the Trade Policy Reviews, give the WTO the information needed to monitor the level and distribution of funding and the opportunity to criticise and propose reforms.

This links aid providers, reporting to the OECD-DAC, to the organisation responsible for trade, the WTO. But the reluctance of the WTO as an organisation to challenge the traditional aid agencies has made the reviews more fora for exchange of information than appraisal mechanisms. The agencies do not subject their decisions on projects to common criteria. After 2006, the stagnation of the Doha Round meant a lack of ongoing trade negotiations in which developing countries could demand changes to aid in return for trade concessions. Therefore, although there have been increased flows of funds for trade-related purposes, there is no way to ensure that these purposes will be influenced by the priorities of the international trading system.

In climate change funding, it has been accepted that there will be a variety of funds. These will also require monitoring to ensure that they are sufficient and appropriate. The experience of Aid for Trade offers to climate change funding lessons on structure, but also warnings on the conditions necessary for effectiveness.

4.2 Linking the Aid for Trade Categories to Climate Change Needs

This section links the categories that are included within Aid for Trade, and items related to enhanced supply-side capacity, to those identified in the ensuing sections as necessary for building climate change resilience. As will be shown, there is considerable overlap and therefore scope for both initiatives to be linked. However, Aid for Trade categories have been linked in this sub-section in a purely suggestive way: more concrete examples requires more in-depth, country-specific analysis.

4.2.1 Trade policy and regulations

The United Nations Environment Programme, UNEP (de Lombaerde and Puri 2009:94–5) has identified needs in environmental policy which closely parallel those in trade capacity building: "A key issue…is the ability of developing countries and developing country experts to meaningfully participate in international standard-setting bodies.…Equally important for developing countries are the issues related to domestic implementation capacities. The third element is related to both of the above and concerns the creation of policy space for meaningful participation by various stakeholders". Carbon labelling is an example of a potentially important advantage for developing countries if they can be assisted in participating more effectively in setting the rules and meeting them. For all these, the types of assistance given to build policy capacity in trade would be relevant to climate-related needs.

Trade policy may also be used as a tool in climate change initiatives. There are proposals to link national initiatives to tax or cap carbon usage to border taxes on countries not accepting similar taxes. Challenging such measures when they violate WTO rules and finding least cost ways of conforming to them when they do not, will mean that countries may need additional training and assistance in analysing trade regulations in order to meet climate objectives.

4.2.2 Trade development

If carbon border taxes are imposed, some developing countries may need assistance in adapting their production to minimise their impact. Securing private finance for the investment needed for climate change adaptation and mitigation may include increasing foreign investment, so assistance in attracting and managing this will be relevant to climate objectives. Some developing countries are likely to need assistance in order to take advantage of the CDM: initial capital investments may be required.

As noted by Halonen (2009), finance related barriers that developing countries face include the high transaction costs associated with CDM project preparation and implementation. CDM projects must conform, in the current commitment period (2008–2012), to the "additionality" clause. That is, CDM projects

must be verifiable and contribute to emission reductions above and beyond the business-as-usual scenario. They must not merely be in compliance with existing legislation.

4.2.3 Trade-related infrastructure

Many of the types of infrastructure in the plans for the agricultural sector included in NAPAs (Annex Table 6) could be related to support for trade as well as enhanced resilience to climate change. These could include, for example, in Guinea, rehabilitating hydro systems; in Guinea-Bissau, protecting production from high tides; and in Senegal, increasing irrigation facilities. There are therefore synergies with Aid for Trade if the investments required to increase the resilience of existing and planned infrastructure to climate change are related to the supply-side capacity of countries to trade.

4.2.4 Building productive capacity

Trade capacity building will need to respond to climate change by assisting countries first to diversify to reduce their vulnerability to these risks and then to find new areas of specialisation and to meet the new regulatory requirements for traded products. The data in Tables 1.3, 1.4, and 1.5 show clearly that for some countries climate change effects will have a major impact on agricultural production and trade. The sizes of the effects are for some countries at least as large as those from preference erosion that triggered interest in Aid for Trade. In some cases, notably Malawi, the most seriously affected countries are the same, strengthening the case for providing coordinated assistance to adjust. Most of the projects in the NAPAs (Annex Table 6) to adapt supply could be related to trade, for example adapting crops to salinity and risks of flooding in Bangladesh, building capacity in the Democratic Republic of Congo, adapting technologies in Guinea, improving crop and livestock production in Madagascar, and adapting agricultural production to erratic precipitation in Malawi.

Barriers to tapping into new market opportunities such as the CDM, may include not only financial barriers but also limited productive capacities, such as the ability to monitor and certify emissions reductions; this would apply equally to carbon labelling initiatives. The building of new trade capacities will be required in the transition to a global low-carbon economy.

4.2.5 Trade-related adjustment

The potential increase in the size and frequency of climate-related shocks will affect traded products: compensation schemes for shocks to supply or to prices of commodities are among the earliest forms of trade-related assistance from the international financial institutions. To the extent that climate change results in increased volatility of weather patterns and climatic shocks on the agricultural sector (but not exclusively) it may also result in greater macroeconomic instability. This suggests that greater attention should be paid to the ability of countries to access international mechanisms designed to cope with exogenous adverse shocks, including those related to climate change.[39]

4.2.6 Other trade-related needs

The Task Force did not want to exclude any measures which a country could show were intended to improve its trade. The category of 'Other trade-related needs' can therefore be used for any trade-related climate projects that do not fall under one of the designated categories. Countries will need to take account of climate change in their respective development plans. Aid that assists with this task could fall under this category.

4.3 COORDINATION AND COMPETITION FOR FUNDING

4.3.1 Trade and climate change

Some agencies involved in supporting trade have already recognised the need to include climate change issues. Most climate-related funds, including the growing number under the World Bank and those proposed by bilateral aid agencies (including EC, UK, Spain, Japan, Germany, Norway, Australia, and Germany) are targeted at adaptation to environmental change, including changes in trade, rather than at the regulatory requirements of the international conventions. Special funds include provisions for assistance on energy use and shifting to low-carbon production. A more general aim is, "what the Bank calls 'climate-proofing' development projects, which it estimates will require a few billion U.S. dollars annually" (Porter et al. 2008:14). Some of these programmes are trade-related. For example, some technical assistance is targeted at increasing analytical capacity, which could have benefits for trade capacity as well, and the fund conditions often emphasise adoption of new technologies. There are obvious complementarities with productivity-increasing technical assistance for trade.

There appears to be no estimate of how much of the total estimated costs of adaptation to climate change may be for trade-related projects. "A Bank paper on climate change has predicted that it would have to increase IDA [International Development Association] funding by 6 percent to 21 percent annually just to maintain the same net level of benefits to recipient countries, compared to a scenario without climate change". (Porter et al. 2008:14). This percentage might be taken as a rough initial estimate of the additional cost of 'climate-proofing' trade capacity building for other donors.

Only a few donors currently cover regulatory needs. UNEP has pointed to the need to link trade and environmental initiatives. Its support of assessments of the environmental impact of trade policy changes in specific sectors led to the publication of the *Reference Manual for the Integrated Assessment of Trade-related Policies* and *Integrated Assessment Guidance for Mainstreaming Sustainability into Policymaking* (UNEP 2001; UNEP 2009; UNIDO 2009). It has promoted work on analysing the relationship between Multilateral Environmental Agreements (MEAs) and trade agreements and published a joint report with the WTO (Tamiotti et al. 2009).

Specialised agencies like the International Civil Aviation Organization, ICAO, and the International Telecommunications Union, ITU, are working to establish international technical standards to limit environmental effects, and could include these in their general support programmes. UNCTAD provides and supports analysis of the links of climate change to trade, investment, and development, including building developing country capacity to adopt consistent trade and environmental policies. It also provides support specifically to help countries meet environmental standards. UNECLAC (United Nations Economic Commission for Latin America and the Caribbean) also provides support for analysis of the impact of climate change and new standards for trade (UNIDO 2009).

All the donors listed in Annex Table 5 as providing funds for mitigation and adaptation in the agricultural sector, except the GEF, are also involved in funding trade-related assistance, so in principle there should be mechanisms for harmonising objectives and coordinating finance. In practice, there are not yet regular checks to ensure compatibility.

4.3.2 Linking funding for specific purposes to official development assistance

Any targeted assistance, mandated by international agreement, causes problems in normal aid terms. Implementing WTO or climate agreements will benefit the world as a whole, and may benefit a country directly. But such changes are not necessarily

priorities for a cash-constrained government, so under normal criteria many implementation costs will not qualify for assistance.

As the World Bank (World Bank 2009) has suggested, the most efficient ways to reduce emissions and improve energy efficiency globally may be through investment in developing countries. Since this is for the benefit of all, this study argues, such investment should be funded by those most able to do so, i.e., through transfers from developed countries. Assistance for adjustment is more directly related to a country's needs, but allocating aid according to the damage from climate change, like allocating it according to a country's costs from preference erosion, is not consistent with the normal criteria for aid, except perhaps for macroeconomic adjustment to exceptional external shocks. The public good and negotiation reasons that led to the acceptance of Aid for Trade—that developing countries must be persuaded to accept an international agreement which will impose costs on them—also apply to climate change related assistance.

There has been discussion and concern about the difficulties of linking trade capacity building to poverty strategies in countries' aid programmes, as there has been about linking environmental aid to poverty strategies (Prowse et al. 2009, for example). Funds targeted at climate change also raise the same issues of inconsistency between targeted assistance and general budget support that are found in trade capacity building (e.g., Bird and Cabral 2009). In both cases there are clear general interests in ensuring that individual countries meet international standards, but the risk remains that countries may choose to give such compliance lower priority than other national interests if country priorities are given precedence over global concerns.

Therefore, since both trade and climate change related programmes have, in part, international objectives and exist for the benefit of countries other than the direct recipients of assistance, they should not be considered quantitatively part of official development assistance. They do not and should not follow the Paris Declaration principles of conforming to national priorities or to the principles for allocation among countries according to poverty or other definition of need that bind some aid agencies and influence most of them. Instead, climate change related funding, in relation to efforts to mitigate climate change should be determined by where it is more efficient to be spent. Funding for adaptation, should be determined by which countries are going to be most affected. This is not the same as 'normal' country priorities of donors or countries.

However, that targeted assistance should be additional to normal ODA does not mean that it should be separate from it at the level of programmes or projects. Indeed, ensuring that a development programme should use trade efficiently and be consistent with limiting climate change and achieving a sustainable pattern of production should be part of any aid programme. This is consistent with the World Bank approach of considering how to 'climate proof' development projects and estimating the costs of doing so. To do this, it is necessary to estimate the additional costs imposed by climate objectives, and increase total ODA by that amount (or, where there is sufficiently disaggregated information on costs, increase different types of ODA by appropriate factors). In practice it is already difficult to separate funding for adaptation or mitigation for climate change from normal adaptation to new trading problems or opportunities and this will become increasing difficult as taking account of climate change becomes a more standard part of project analysis.

By accepting the explicit objective of 'helping countries to trade', bilateral donor countries that are members of the WTO added an international obligation to their existing objectives for their aid programmes. The same would be true for aid related to climate change. For those donors that have mandates explicitly directed at poverty reduction, this addition requires some modification or reinterpretation

of aid priorities, or clearly separated budget lines. The new focus on trade also brought a need for different types of expertise; in some cases this has been met by allocating more financing through multilateral or specialised agencies. The same would be needed for climate change related assistance.

There will be temptations for those concerned with any special need, including trade and climate change, to try to divert funds from those for general development or from those for potentially related needs. This creates conflicts. As is shown by the calculations of the additional costs of 'climate-proofing' existing projects, any new purpose for Aid for Trade would require additional funding to avoid diversion from existing needs. How far should funding intended to help developing countries to build trade capacity be used for needs created by other policy interventions, such as international climate change conventions? How far should environmental or trade funding based on the interests of the global community, displace assistance determined by the needs and priorities of each country?

5. CONCLUDING REMARKS

There are going to be two types of impact made by climate change on the agricultural sector. The first is from climate change itself: climate change will necessitate changes in what is produced, what is traded, and how it is traded, because the new conditions will make some old types of production or trade impossible. Among the most important types of change likely to affect developing countries' current production patterns are changes in rainfall and other changes in the supply of water, altering the competitiveness of different areas in producing cereals (Tables 1.1 and 1.2). Temperature changes will also change the areas capable of producing tropical and sub-tropical crops, including major export revenue generators like coffee. Sub-Saharan Africa, Latin America, and South Asia are likely to have to produce new commodities, while South-East Asia, like some developed areas, may be able to increase current production. Changes in sea level will reduce the supply of land in some areas. Increased risk of extreme climatic shocks may shift the balance of production towards locations that are more resilient to shocks, even at the cost of reduced productivity.

The second type of changes relates to the imposition of new regulations, both multinational and national, which will impose new product standards and new costs of meeting regulations and demonstrating compliance. The negotiation of new conventions also imposes new costs and the need for new skills. New regulations could include new requirements on standards and labelling (e.g., carbon labelling). There are risks that some countries will take unilateral action to restrict trade (e.g. border tax adjustments to complement national measures), which will require developing countries to respond or adapt. Climate change will affect the availability of and the regulations governing the use of different energy sources which will affect energy use. Changes in energy use will, in turn, increase costs by variable amounts, which will affect the competitiveness of different products and producers, including agricultural products and producers.

On the demand side, climate change will stimulate demand for low-carbon or clean energy sources; this may include crops produced for biofuels. Trade and the patterns of production which result from different trade regimes or capacity to trade, in turn affect the climate. Assistance directed at trade must take these effects into account. If all inputs are priced to reflect both their scarcity and any external diseconomies, then shifting production to the most efficient producers should reduce the impact on climate as well as improving development prospects. To the extent that prices are wrong, assistance to trade should encourage better policy and avoid relying on distorted prices to identify trading opportunities.

Although the funds currently available for adaptation and mitigation efforts are low compared to what is estimated to be necessary, the climate change finance architecture is new and growing. There is scope for some developing countries to benefit significantly from the new sources of finance that may result from climate change mitigation efforts, including the CDM and other voluntary, national, or regional schemes in the future. It is inherently difficult to value all types of terrestrial carbon, such as that which is locked up in soils, but doing so would go far to redress the fact that many of the countries most vulnerable to the effects of climate change have, to date, been bypassed by mitigation finance. Given the moves towards optimisation within a carbon constrained world, steps taken now to build capacity and awareness of carbon assets and liabilities, and to build the available options to realise low-carbon opportunities, will be a key pillar of future growth and poverty reduction strategies.

How could and should new sources of climate change finance and existing trade facilitation measures work together to address the challenges of climate change in the agricultural sector? As discussed in the preceding sections there is clearly much scope: many of the donors that have provided mitigation and adaptation finance are also involved in trade-related assistance. However, the current absence of standardised checks to ensure compatibility suggests that coordination between institutions and programmes needs to be improved; such coordination may, at the same time, serve to reduce potential conflicts between competing demands and agendas.

The Aid for Trade initiative, like climate change mitigation and adaptation finance, is in part, about delivery of global public goods. In all these cases, funding must be additional and not diverted from other sources. The need to establish and delineate financing mechanisms that can stand alone if necessary becomes even more important in the current environment of donor resource constraint.

REFERENCE LIST

AITIC (2009). *Handbook of Aid for Trade Providers*. Geneva: Agency for International Trade Information and Cooperation.

AITIC (2009). *Trade Liberalisation and Climate Change*. Geneva: Agency for International Trade Information and Cooperation (Trade and Development Briefs, August).

AITIC (2009). *Trade Measures to support Climate Change Policies*. Geneva: Agency for International Trade Information and Cooperation (Trade and Development Briefs, September).

Baker, P (2009). *Climate change brews up trouble for coffee growers*. Cairo: Science and Development Network (5 August).

Bird, Nl and Cabral, L (2009). *Changing aid delivery and the environment: can General Support Budget be used to meet environmental objectives.* London: Overseas Development Institute (Briefing Paper 17).

Brenton, P, Edwards-Jones, G and Jensen, M (2008). *Carbon Labelling and Low Income Country Exports: An Issues Paper*. Munich Personal RePEc Archive paper No. 8971. Obtained from: http://mpra.ub.uni-muenchen.de/8971/1/MPRA_paper_8971.pdf

Brown, J, Vigneri M and Sosis K (2008). *Innovative Carbon-based Funding for Adaptation*. Obtained from: http://www.odi.org.uk/ccef/resources/reports/s0198_oecd_adaptation.pdf

Brown, D. (2009), Ethical Issues in the Use of Cost-Benefit Analysis of Climate Change Programs, http://climateethics.org/?p=36

CAIT (2009). Climate Analysis Indicators Tool. Washington, DC: World Resources Institute. Obtained from: http://cait.wri.org/ (data downloaded 20 August and 21 September 2009).

Capoor, K and Ambrosi, P (2008). *State and Trends of the Carbon Market 2008*. Washington, DC: World Bank Institute. Obtained from:
http://siteresources.worldbank.org/NEWS/Resources/State&Trendsformatted06May10pm.pdf

CEA (2007). Design to win: philanthropy's role in the fight against global warming. San Francisco CA: California Environmental Associates. Obtained from:
http://greengrants.org/pdf/design_to_win.pdf

Christensen, JH, Hewitson, B, Busuioc, Chen, A, et al. (2007). Regional climate projections. In: Solomon S, et al. (eds.). *Climate Change 2007: The Physical Science Basis. Contribution of Working Group I to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. Cambridge: Cambridge University Press, pp. 847–940.

Christoplos, I (2009). *Aid for Pro-Poor Agricultural Trade in the Context of Climate Change*. London/Glemmingebro, Sweden: GRM International/Glemminge Development Research. Obtained from: http://www.acp-eu-trade.org/library/files/Christoplos_EN_040509_GRM-GDR_Aid-for-pro-poor-agricultural-trade-in-a-context-of-climate-change.pdf

Cline, W (2007). *Global Warming and Agriculture: Impact Estimates by Country*. Washington, DC: Centre for Global Development.

EC (2007). *Communication from the Commission to the Council, the European Parliament, the European Economic and Social Committee and the Committee of the Regions. Towards an EU Aid for Trade Strategy – the Commission's contribution*. Brussels: Commission of the European Communities (COM(2007) 163 final). Obtained from: http://ec.europa.eu/commission_barroso/michel/Policy/key_documents/docs/COMM_PDF_COM_2007_0163_F_EN_ACTE.pdf

EC (2008). *Proposal for a Directive of the European Parliament and of the Council on the promotion of the use of energy from renewable sources*. Brussels: Commission of the European Communities (COM(2008) 19 final, 2008/0016 (COD)). Obtained from: http://ec.europa.eu/energy/climate_actions/doc/2008_res_directive_en.pdf

EC (2009a). *Commission Staff Working Paper accompanying the Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Supporting developing countries in copying with the crisis: Aid for Trade Monitoring Report 2009*. Brussels: Commission of the European Communities (SEC(2009) 442/2). Obtained from: http://www.eepa.be/wcm/dmdocuments/EC_Aid-for-Trade-monitoring-report-2009_EN.pdf

EC (2009b). *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Towards a comprehensive climate change agreement in Copenhagen.* Brussels: Commission of the European Communities (COM(2009) 39 final). Obtained from: http://ec.europa.eu/environment/climat/pdf/future_action/communication_en.pdf

EC (2009c).

De Lombaerde, P, Puri, L (eds.), (2009). *Aid for Trade: Global and Regional Perspectives*. *Second World Report on Regional Integration.* New York, NY: Springer (UNU Series on Regionalism, Vol. 2).

Edwards-Jones, G, Hounsome, B, Canals, MI, York L, et al. (2009). Vulnerability of exporting nations to the development of a carbon label in the United Kingdom. *Environmental Science & Policy* 12(4):479–490

EurActiv (2009). *Commission says farmers need help to cut carbon*. 16 September. Obtained from: http://www.euractiv.com/en/cap/commission-farmers-need-help-cut-carbon/article-185476

FAO (2009). *Anchoring Agriculture within a Copenhagen Agreement: A policy brief for UNFCCC parties by the FAO*. Rome: Food and Agriculture Organization, Obtained from: http://www.fao.org/forestry/foris/data/nrc/policy_brief_sbstabonn.pdf

FAO (2007). *Adaptation to climate change in agriculture, forestry and fisheries: Perspective, framework and priorities*. Rome: Food and Agriculture Organization, Interdepartmental Working Group on Climate Change. Obtained from: ftp://ftp.fao.org/docrep/fao/009/j9271e/j9271e.pdf

ODI (2008a).

Giorgi, F, Bi, X and Pal, J (2004). Mean, interannual variability and trends in a regional climate change experiment over Europe, II: climate change scenarios (2071-2100). *Climate Dynamics*, 23(7–8):839–858.

Halonen, M (2009). *Clean Development Mechanism – Barriers and potential ways forward. Expert Meeting on Trade and Climate Change: Trade and Investment Opportunities and Challenges under the Clean Development Mechanism (CDM), 27-29 April 2009*. Geneva: United Nations Conference on Trade and Development. Obtained from: http://www.unctad.org/sections/wcmu/docs/c1em1p10_en.pdf

Hidalgo, C, Klinger, B, Barabasi, A, et al. (2007). The Product Space Conditions the Development of Nations. *Science*, 317:482

IPCC (2000). *Special Report on Emission Scenarios*. Geneva: Intergovernmental Panel on Climate Change. Obtained from: http://www.grida.no/publications/other/ipcc_sr/?src=/climate/ipcc/emission/

IPCC (2001).

IPCC (2007a). *Contribution of the Working Group III to the fourth assessment report of the Intergovernmental Panel on Climate Change, Chapter 8*. Geneva: Intergovernmental Panel on Climate Change. Obtained from: http://www.ipcc.ch/pdf/assessment-report/ar4/wg3/ar4-wg3-chapter8.pdf

IPCC (2007b). *Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*. In: Parry, ML, et al., (eds.). Cambridge: Cambridge University Press.

Josling and Blandford
Ludi, E, Stevens, C, Peskett, and Cabral, L (2007). *Climate Change and Agriculture: Agricultural Trade, Markets and Investment (draft)*. London: Overseas Development Institute (March). Obtained from: http://www.odi.org.uk/resources/download/1261.pdf

McCarl, B (2007). *Adaptation Options for Agriculture, Forestry and Fisheries. A report to the UNFCCC Financial and Technical Support Division*. Bonn: United Nations Framework Convention on Climate Change. Obtained from: http://unfccc.int/files/cooperation_and_support/financial_mechanism/application/pdf/mccarl.pdf

McKinsey and Company (2009a). *Pathways to a Low-Carbon Economy, Version 2 of the Global Greenhouse Gas Abatement Cost Curve.*

Nelson, GC (2009). *Climate Change and Agriculture*. Washington, DC: International Food Policy Research Institute (February).

ODI (2008a). *Review of the Indirect Effects of Biofuels: Economic benefits and food security, Report to the Renewable Fuels Agency (RFA)*. London: Overseas Development Institute. Obtained from: www.dft.gov.uk/rfa/_db/_documents/Report_of_the_Gallagher_review.pdf

ODI (2008b). *Are Ethical and Fair Trade Schemes Working for Poor Producers or Do We Need a Good for Development Label?* London: Overseas Development Institute. Obtained from http://www.odi.org.uk/resources/download/2457.pdf

ODI (2008c). *Achieving Green Growth in a Carbon Constrained World, Background Note*. London: Overseas Development Institute (October). Obtained from: http://www.odi.org.uk/resources/download/2449.pdf

Page, S (2007). *The Potential Impact of the Aid for Trade Initiative*. Geneva: United Nations Conference on Trade and Development (G24 Discussion Paper Series 45).

Porter, G, Bird, N, Kaur, N and Peskett, L (2008). *New Finance for Climate Change and the Environment.* Gland/Berlin: World Wildlife Fund/Heinrichöll Stiftung. Obtained from: http://www.odi.org.uk/resources/download/2980.pdf

Prowse, M, Grist, N and Sourang, C (2009). *Closing the gap between climate adaptation and poverty reduction frameworks*. London: Overseas Development Institute (ODI Project Briefing 21).

Reed, D (ed.), (2009). *The Institutional Architecture for Financing a Global Climate Deal: An Options Paper,* Technical Working Group for the Danish Government.

Reilly, J M and Schimmelpfennig D (1999). Agricultural Impact Assessment, Vulnerability, and the Scope for Adaptation. *Climatic Change*, 43(4):745–788.

Ruosteenoja K, Carter TR, Jylhä K and Tuomenvirta H (2003). *Future climate in world regions: an intercomparison of model-based projections for the new IPCC emissions scenarios*. Helsinki: The Finnish Environment Institute (Finnish Environment 644).

South Centre (2009). The Rise of "Climate Protectionism", *South Bulletin*, Issue 40 [Internet]. Obtained from:
http://www.southcentre.org/index.php?option=com_content&task=view&id=1081&Itemid=279

Stern, N (2008). *Key Elements of a Global Deal on Climate Change*. London: London School of Economics and Political Science. Obtained from:
http://www.occ.gov.uk/activities/stern_papers/Key%20Elements%20of%20a%20Global%20Deal%20-Final01may.pdf

Tamiotti, L, et al. (2009). *Trade and Climate Change. A report by the United Nations Environment Programme and the World Trade Organization*. Geneva: World Trade Organization. Obtained from:
http://www.wto.org/english/res_e/booksp_e/trade_climate_change_e.pdf

UNCTAD (2009). *The Clean Development Mechanism – Guide 2009*. Geneva: United Nations Conference on Trade and Development. Obtained from: http://www.unctad.org/templates/webflyer.asp?docid=11809&intItemID=4342&lang=1

UNDP (2008). *Human Development Report 2007/2008. Fighting Climate Change: Human solidarity in a divided world*. New York, NY: United Nations Development Programme. Obtained from:
http://hdr.undp.org/en/media/HDR_20072008_EN_Complete.pdf

UNEP (2001). Reference Manual for the Integrated Assessment of Trade Related Policies. Geneva: United Nations Environment Programme. Obtained from:
http://www.unep.ch/etu/etp/acts/manpols/refmania_final.pdf

UNEP (2009). Integrated Policymaking for Sustainable Development: A reference manual. Geneva: United Nations Environment Programme. Obtained from: http://www.unep.ch/etb/publications/IPSD%20manual/UNEP%20IPSD%20final.pdf

UNFCCC (2007). *Investment and Financial Flows to Address Climate Change*. Bonn: United Nations Framework Convention on Climate Change Secretariat.

UNIDO (2009). *Trade Capacity Building: Inter-Agency Resource Guide*. Geneva: United Nations Industrial Development Organization.

Wheeler, T and Tiffin, R (2009). Costs of adaptation in agriculture, forestry and fisheries. In: Parry M, et al. *Assessing the Costs of Adaptation to Climate Chang: A Review of the UNFCCC and Other Recent Estimates*. London: International Institute for Environment and Development and Grantham Institute for Climate Change, pp. 29–39. Obtained from: http://www.iied.org/pubs/pdfs/11501IIED.pdf

Williams, AG (2007). *Comparative study of cut roses for the British market produced in Kenya and the Netherland: A report for World Flowers*. Cranfield, United Kingdom:
Cranfield University.

World Bank (2009a). *World Development Report 2010: Development and Climate Change.* Washington DC.

World Bank (2009b). *World Bank list of economies (July 2009)*, Washington DC. Obtained from http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20420458~menuPK:64133156~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html

WRI (2009). *Climate analysis indicators tool*. Washington DC: World Resources Institute. Obtained from: http://cait.wri.org/

WTO (2005). *Doha Work Programme, Ministerial Declaration in Hong Kong, WT/MIN(05)/W/3/Rev.2, December 1*8. Geneva: World Trade Organization.

WTO (2006). *Recommendations of the Task force on Aid for Trade, WT/AFT/1*. Geneva: World Trade Organization.

WTO/UNEP (2009) *Trade and climate change, WTO-UNEP Report*. Geneva: World Trade Organization. Obtained from:
http://www.unep.ch/etb/pdf/UNEP%20WTO%20launch%20event%2026%20june%202009/Trade_&_Climate_Publication_2289_09_E%20Final.pdf

National Adaptation Plans of Action (NAPAs) Reviewed

Banglasdesh

Government of the People's Republic of Bangladesh. Ministry of Environment and Forest (2005). *National Adaptation Programme of Action (NAPA): Final Report*. Dhaka. Obtained from: http://unfccc.int/resource/docs/napa/ban01.pdf

Cambodia
Royal Government of Cambodia. Ministry of Environment (2006). *National adaptation programme of action to climate change (NAPA)*. Phnom Penh. Obtained from:
http://unfccc.int/resource/docs/napa/khm01.pdf

United Nations Framework Convention on Climate Change. (2006?). *Cambodia project list*. Bonn. Obtained from:
http://unfccc.int/files/adaptation/napas/application/pdf

Democratic Republic of the Congo
République Démocratique du Congo. Ministère de l'Environnement (2006). *Programme d'Action National d'Adaptation au Changement Climatique de la Républlique Démocratique du Congo* [National Adaptation Programme of Action on Climate Change of the Democratic Republic of Congo]. Kinshasa. Obtained from:
http://unfccc.int/resource/docs/napa/cod01.pdf

Guinea
République de Guinee. Ministère de l'Agriculture, de l'Elevage, de l'Environnement, des Eaux et Forêts, Conseil National de l'Environnement (2007). *Plan d'Action National d'Adaptation aux changements climatique (PANA) de la république de Guinee [National Adaptation Programme of Action on Climate Change (NAPA) of the Republic of Guinea].* Conakry. Obtained from:
http://unfccc.int/resource/docs/napa/gin01f.pdf

United Nations Framework Convention on Climate Change (2007?). *National Adaptation Programmes of Action, Index of NAPA Projects by Country: Guinea.* Bonn, pp. 9–11.
http://unfccc.int/files/adaptation/application/pdf/napa_index_country.pdf

Guinea-Bissau
United Nations Framework Convention on Climate Change (2007?). *Guinea Bissau: NAPA Project Profile.* Bonn. Obtained from:
http://unfccc.int/files/adaptation/napas/application/pdf/15_guineab_pp.pdf

Madgascar
République de Madagascar, Ministère de l'Environnement, des Eaux et Forêts (2001?). *Programme d'Action National d'Adaptation au changement climatique [National Adaptation Programme of Action on climate change]*. Antananarivo. Obtained from:
http://unfccc.int/resource/docs/napa/mdg01f.pdf

Malawi
Republic of Malawi. Ministry of Mines, Natural Resources and Environment
Environmental Affairs Department (2006). *Malawi's National Adaptation Programmes of Action (NAPA) under the United Nations Framework Convention on Climate Change (UNFCCC), First Edition*. Lilongwe. Obtained from:
http://unfccc.int/resource/docs/napa/mwi01.pdf

Senegal
Répubique du Sénégal. Ministère de l'Environnement et de la Protection de la Nature (2006). *Plan*

d'Action National pour l'Adaptation aux changements climatiques [National Adaptation Programme of Action on Climate Change]. Dakar. Obtained from:
http://unfccc.int/resource/docs/napa/sen01f.pdf

United Republic of Tanzania (the)
United Nations Framework Convention on Climate Change (2007?). Tanzania*: NAPA Project Profile.* Bonn. Obtained from: http://unfccc.int/files/adaptation/napas/application/pdf/34_tanz_pp.pdf

Zambia
Republic of Zambia. Ministry of Tourism, Environment and Natural Resources (2007). *Formulation of the National Adaptation Programme of Action on Climate Change: Final Report*. Lusaka. Obtained from: http://unfccc.int/resource/docs/napa/zmb01.pdf

United Nations Framework Convention on Climate Change (2007?). *National Adaptation Programmes of Action, Index of NAPA Projects by Country*: Zambia. Bonn, p. 31. Obtained from:
http://unfccc.int/files/adaptation/application/pdf/napa_index_country.pdf

ENDNOTES

1 See Nelson (2009), who also notes that uncertainties over where climate changes will take place mean lack of clarity about the effects on agricultural production. These uncertainties combine with the complexity of the agricultural policy environment to make accurate simulations difficult to achieve.

2 Anderson, K. (2009) The Challenge of Growth: Can growth be compatible with climate change mitigation targets?

3 See Christoplos (2009): http://www.acp-eu-trade.org/library/files/Christoplos_EN_040509_GRM-GDR_Aid-for-pro-poor-agricultural-trade-in-a-context-of-climate-change.pdf

4 Terrestrial carbon' relates to both forestry and the agricultural sector and includes: halting deforestation, reforesting marginal areas of land and sequestering more 'carbon' (or 'carbon equivalent', CO2e) in soils by changing agricultural practices.

5 See Nelson (2009), who also notes that uncertainties over where climate changes will take place mean lack of clarity about the effects on agricultural production. These uncertainties combine with the complexity of the agricultural policy environment to make accurate simulations difficult to achieve.

6 See Christoplos (2009): http://www.acp-eu-trade.org/library/files/Christoplos_EN_040509_GRM-GDR_Aid-for-pro-poor-agricultural-trade-in-a-context-of-climate-change.pdf

7 See Ludi et al. (2007): http://www.odi.org.uk/resources/download/1261.pdf

8 GCMs are mathematical representations of the general circulation of a planetary atmosphere or ocean and have been developed by various research centres. Typically, they differ in terms of projected temperature change and climate sensitivity.

9 The most recent assessment report of the IPCC draws on climate change impact, adaptation, and vulnerability (CCIAV) assessments. Most CCIAVs provide scenarios of the future emissions trajectories based on assumptions in relation to socio-economic and technological development.

10 With reference to the FAO Committee on Food Security, Report of 31st Session 2005.

11 Although these estimates are based on a range of scenarios, clearly an increase in temperatures across regions is predicted, even in the most optimistic that have been reviewed.

12 These estimates are a mean value of the results of a Ricardian statistical model and a process-based agronomic crop model (Cline 2007).

13 As noted by Cline (2007:24), carbon dioxide is an input to photosynthesis, which uses solar energy to combine water and carbon dioxide to produce carbohydrates, with oxygen as a waste product. Higher atmospheric concentrations of carbon dioxide also reduce plants stomatal (pore) openings and hence the loss of water to respiration. Crops which are posited to benefit from the effects of carbon fertilisation include: rice, wheat, soybeans, fine grains, legumes, and most trees; benefits for other crops such as maize, millet, sorghum, and sugarcane are much more limited.

14 These categories correspond to those identified by Ludi et al. (2007), who identify the following scenarios: 1. Export agricultural declines; 2. Capital intensive agricultural exports increase; and 3.Labour-intensive exports increase.

15 Further to the estimates of McCarl (2007) and critical review undertaken by Wheeler and Tiffin (2009), IFPRI similarly suggests increased investment over baseline to adapt to climate change, the results of which are presented in Annex Table 3 (Nelson et al. 2009). However, similar to McCarl (2007), and as highlighted by Wheeler and Tiffin (2009), one of the major shortfalls of applying a 'climate mark-up' is that current investment flows to the agricultural sector are typically much lower than what is required to get countries up to their production possibility frontier, which results in an 'adaptation deficit', which is largely a 'development deficit' (Ibid:11).

16 For example, Wheeler and Tiffin (2009:11) note that the estimated costs of climate change proofing capital investments are made on the assumption that two percent of current investment is climate sensitive.

17 To avoid an increase in temperature of not more than 2o C compared to pre-industrial levels.

18 See Annex Table 1.

19 Some voluntary carbon markets already include the forestry sector.

20 As of August 2008, over half of all registered projects were based in either India (30 percent) or China (22 percent) with only 2 percent located in sub-Saharan Africa (Gallagher 2008). This bias towards middle income countries has also been highlighted in the World Banks (2009) World Development Report.

21 A recent policy brief produced by the FAO (2009) also makes this point. It states that: inclusion of agriculture in developing country Nationally Appropriate Mitigation Actions (NAMAs) may also help to balance the exclusion of most forms of agricultural mitigation from the Clean Development Mechanism of the Kyoto Protocol.

22 A companion bill—the Kerry-Boxer bill—is pending before the Senate. If it is approved, the two will need to be reconciled.

23 See http://www.ft.com/cms/s/0/2f99b984-61e9-11de-9e03-00144feabdc0.html. For a brief summary of the Act, see: http://energycommerce.house.gov/index.php?option=com_content&view=article&id=1697:house-passes-historic-waxman-markey-clean-energy-bill&catid=155:statements&Itemid=55

24 This was announced by the European Agriculture Commissioner, see EurActiv (2009). A Commission Staff Working Document assessed the role of European agriculture in climate change mitigation and suggested that the, "revision of accounting rules for land use, land use change and forestry under the UNFCCC and Kyoto Protocol will be important in [the development of stronger incentives for soil protection and management and the protection of carbon-rich soils such as grasslands]" (Commission of the European Communities 2009c:4).

25 ODI (2008a).

26 This section focuses on low carbon products in the agricultural sector, as opposed to more generally.

27 The transportation of horticultural products is usually undertaken with chartered tourist flights.

28 More biofuel means less use of fossil fuels. This reduces some countries' reliance on oil imports, and

may also benefit those developing countries that cannot grow biofuel feedstock, but which would benefit from the lower global oil prices that would result from reduced global demand for fossil fuels. The findings of the Gallagher Review (2008) concede that there is a role for a sustainable biofuels industry, but that feedstock production must be avoided on agricultural land that would otherwise be used for food production, see Ellis and Keane (2008) and Gallagher (2008).

29 See Ellis and Keane (2008) for a review of a range of ethical standards for which compliance costs are typically high and scope of developing country exporters, low.

30 It is also noted that, within the international framework for the CDM, many legal, financial and technical issues are currently under discussion in the context of the Bali Roadmap.

31 See Annex Table 3.

32 Whilst cap and trade schemes create certainty as to the quantity of emissions reduced, they may lead to uncertainty and volatility in carbon prices (if there is no commensurate management to reduce price volatility).

33 See World Bank (2009a:268) for discussion on the relative merits of carbon taxes versus cap and trade schemes.

34 See www.climatefundsupdate.org for further details on how climate change finance funds are being developed, what they support, and the scale and the disbursements so far.

35 An Adaptation Fund (AF) has also been set up under the Kyoto Protocol. The AF will finance concrete adaptation projects and programmes in developing countries that are particularly vulnerable to the impacts of climate change.

36 See http://www.guardian.co.uk/environment/2009/feb/20/climate-funds-developing-nations and http://www.climatefundsupdate.org/

37 Further analysis across NAPA categories may be necessary before drawing definitive conclusions, since some interventions related to the agricultural sector may fall in other categories, such as 'forestry'.

38 The principle of 'restorative justice' is a branch of ethics that examines how responsibilities should ethically be assigned to those already causing harm. As noted by Brown (2009), because climate change emissions are already causing harm and future emissions limitations are needed to prevent future harm, climate change is a problem that requires thinking through what justice requires as a matter of both distributive and restorative justice. Because nations should follow principles of both distributive and restorative justice in allocating emissions targets among nations, nations should explain how their proposed emissions commitments in the Copenhagen negotiations comport with these ethical considerations.

39 Such mechanisms include the commodity compensation programmes and exogenous shock facilities provided by the IMF, which have recently been made more flexible and accessible given the recent food and financial crises.

40 See http://register.consilium.europa.eu/pdf/en/08/st11/st11994.en08.pdf

ANNEX

Table 1: Non-Annex 1 Parties to the UNFCCC

Afghanistan	Djibouti	Malawi	San Marino
Albania	Dominica	Malaysia	Sao Tome and Principe
Algeria	Dominican Republic	Maldives	Saudi Arabia
Angola	Ecuador	Mali	Senegal
Antigua and Barbuda	Egypt	Malta	Serbia
Argentina	El Salvador	Marshall Islands	Seychelles
Armenia	Equatorial Guinea	Mauritania	Sierra Leone
Azerbaijan	Eritrea	Mauritius	Singapore
Bahamas	Ethiopia	Mexico	Solomon Islands
Bahrain	Fiji	Micronesia (Federated	South Africa
Bangladesh	Gabon	States of)	Sri Lanka
Barbados	Gambia	Mongolia	Sudan
Belize	Georgia	Montenegro	Suriname
Benin	Ghana	Morocco	Swaziland
Bhutan	GrenadWa	Mozambique	Syrian Arab Republic
Bolivia	Guatemala	Myanmar	Tajikistan
Bosnia and Herzegovnia	Guinea	Namibia	Thailand
Botswana	Guinea-Bissau	Nauru	Timor-Leste
Brazil	Guyana	Nepal	Togo
Burkina Faso	Haiti	Nicaragua	Tongo
Burundi	Honduras	Niger	Trinidad and Tobago
Cambodia	India	Nigeria	Tunisia
Cameroon	Indonesia	Niue	Turkmenistan
Cape Verde	Iran (Islamic Republic of)	Oman	Tuvalu
Central African Republic	Israel	Pakistan	Uganda
Chad	Jamaica	Palau	United Arab Emirates
Chile	Jordan	Panama	United Republic of
China	Kazakhstan	Papua New Guinea	Tanzania, United Republic
Colombia	Kenya	Paraguay	of
Comoros	Kiribati	Peru	The former Yugoslav
Congo	Kuwait	Philippines	Republic of Macedonia
Cook Islands	Kyrgyzstan	Qatar	Uruguay
Costa Rica	Lao People's Democratic	Republic of Korea	Uzbekistan
Cuba	Republic	Republic of Moldova	Vanuatu
Cyprus	Lebanon	Rwanda	Venezuela (Bolivarian
Côte d'Ivoire	Lesotho	Saint Kitts and Nevis	Republic of)
Democratic People's	Liberia	Saint Lucia	Viet Nam
Republic of Korea	Libya	Saint Vincent and the	Yemen
Democratic Republic of	Madagascar	Grenadines	Zambia
the Congo		Samoa	Zimbabwe

Source: http://unfccc.int/parties_and_observers/parties/non_annex_i/items/2833.php

Table 2 : Countries for which GHG emissions data are missing

International bunkers	LUCF	PFC, HFC & SF_6
Afghanistan	Antigua and Barbuda	Congo
Antigua and Barbuda	Armenia	Fiji
Bahamas	Azerbaijan	Papua New Guinea
Barbados	Barbados	Samoa
Belize	Belgium	Seychelles
Bhutan	Brunei	
Bosnia and Herzegovina	Cape Verde	
Burkina Faso	Comoros	
Burundi	Dominica	
Cape Verde	Eritrea	
Central African Republic	Georgia	
Chad	Grenada	
Comoros	Iceland	
Congo	Kazakhstan	
Djibouti	Kiribati	
Dominica	Kyrgyzstan	
Equatorial Guinea	Luxembourg	
Fiji	Macedonia, FYR	
Gambia	Maldives	
Grenada	Mauritania	
Guinea	Mauritius	
Guinea-Bissau	Moldova	
Guyana	Palau	
Kiribati	Saint Kitts and Nevis	
Korea (North)	Saint Lucia	
Laos	Saint Vincent and Grenadines	
Lesotho	Seychelles	
Liberia	Taiwan	
Madagascar	Tajikistan	
Malawi	Trinidad and Tobago	
Maldives	Turkmenistan	
Mali	Ukraine	
Mauritania	United Arab Emirates	
Mauritius	Uzbekistan	
Namibia		
Niger		
Palau		
Papua New Guinea		
Qatar		
Rwanda		
Saint Kitts and Nevis		
Saint Lucia		

Table 2: Continued

International bunkers	LUCF	PFC, HFC & SF_6
Saint Vincent and Grenadines		
Samoa		
Sao Tome and Principe		
Seychelles		
Sierra Leone		
Solomon Islands		
Suriname		
Swaziland		
Tonga		
Turkmenistan		
Uganda		
Vanuatu		

Table 3: Additional Annual Investment Expenditure Needed to Counteract the Effects of Climate Change on Nutrition (Million 2000 US$)

Scenario	South Asia	East Asia and the Pacific	Europe and central Asia	Latin America adn the Caribbean	Middle East and North Africa	Sub-Saharan Africa	Developing countries
NCAR with developing- country investments							
Agricultural research	172	151	84	426	169	314	1,316
Irrigation expansion	344	15	6	31	-26	537	907
Irrigation efficiency	999	686	99	129	59	187	2,158
Rural roads (area expansion)	8	73	0	573	37	1,980	2,671
Rural roads (yield increase)	9	9	10	3	1	35	66
Total	1,531	934	198	1,162	241	3,053	7,118
CSIRO with developing- country investments							
Agricultural research	185	172	110	392	190	326	1,373
Irrigation expansion	344	1	1	30	-22	529	882
Irrigation efficiency	1,006	648	101	128	58	186	2,128
Rural roads (area expansion)	16	147	0	763	44	1,911	2,881
Rural roads (yield increase)	13	9	11	3	1	36	74
Total	1,565	977	222	1,315	271	2,987	7,338

Source: Nelson et al. (2009)
Note: Results are based on crop model yield changes that do not include CO_2 fertilisation effects; NCAR: National Center for Atmospheric Research; CSIRO: Commonwealth Scientific and Industrial Research Organisation (Australia).

Table 4: Potential Sources of Mitigation and Adaptation Finance

Proposal	Source of funding	Note	Annual funding ($ billions)
Group of 77 and China	0.25-0.5 per cent of gross national product of Annex I Parties	Calculated for 2007 gross domestic product	201-402
Switzerland	$2 a ton of CO2 with a basic tax exemption of 1.5 ton CO2 per inhabitant	Annually (based on 2012 projections)	18.4
Norway	2 per cent of auctioning AAUs	Annually	15-25
Mexico	Contributions based on GDP, greenhouse gases, and population and possibly auctioning permits in developed countries	Annually, scaling up as GDP and emissions rise	10
European Union	Continue 2 per cent levy on share of proceeds from CDM	Ranging from low to high demand in 2020	0.2-0.68
Bangladesh, Pakistan	3-5 per cent levy on share of proceeds from CDM	Ranging from low to high demand in 2020	0.3-1.7
Colombia, least developed countries	2 per cent levy on share of proceeds from Joint Implementation and emissions trading	Annually, after 2012	0.03-2.25
Least developed countries	Levy on international air travel (IATAL)	Annually	4-10
Least developed countries	Levy on bunker fuels (IMERS)	Annually	4-15
Tuvalu	Auction of allowances for international aviation and marine emissions	Annually	28

Source: World Bank (2009a), taken from UNFCCC (2008a)
Note: AAU: Assigned Amount Unit; IATAL: International Air Travel Adaptation Levy; IMERS: International Maritime Emission Reduction Scheme. Annex I Parties include the high-income countries that were members of the OECD in 1992, plus countries with economies in transition.

Table 5: International Public Funds for Mitigation and Adaptation in the Agricultural Sector

Administered by	Name	Pledged (USD Millions)	Deposited (USD Millions)	Possible Interventions Related to Agriculture (Mitigation or Adaptation).	Resources Available for Agricultural Sector
Adaptation Fund	Adaptation Fund Boards	300 (est. Revenue from CERs)	300 (est. Revenue from CERs)	No specific information available yet as the Fund will start operating in 2009.	No specific information available.
World Bank	Clean Technology Fund	2 149	103	There are currently three investment plans available—for Turkey, Mexico, Egypt—but no projects specifically related to agriculture.	No specific information available.
Japan	Cool Earth Partnership	10 000	unknown	It provides assistance to developing countries that are already making efforts to reduce greenhouse gas emissions to enable them to achieve low-carbon economic growth, but no agriculture-related projects mentioned.	No specific information available.
United Kingdom	Environmental Transformation Fund– International Window	800	100	The ETF-IW will support the activities of the following World Bank-administered CIFs: Clean Technology Fund, Strategic Climate Fund, and related sub-components.	No specific information available.
GEF	GEF Trust Fund – Climate Change focal area	3 130	2 389	• Efficient Utilization of Agricultural Wastes (China); • Biomass-based Power Generation and Co-generation in the Malaysian Palm Oil Industry (Malaysia); • Renewable Energy for Agriculture (Mexico); • Obtaining Biofuels and Non-wood Cellulose Fiber from Agricultural Residues/Waste (Peru); • Greening the Tea Industry in East Africa (Zambia, Mozambique, Burundi, Rwanda, Malawi, Tanzania, Uganda, Kenya).	US$23.5 million already disbursed for the projects listed.
European Commission	Global Climate Change Alliance	375	unknown	No specific information available.	Approximately US$2.5 million to be disbursed.[31]
Germany	International Climate Initiative	157	157	No specific information available.	No specific information available.
GEF	Least Developed Countries Fund	172	131	• Integrated Adaptation Programme to Combat the Effects of Climate Change on Agricultural Production and Food Security in Benin (Benin); • Strengthening Adaptation Capacities and Reducing the Vulnerability to Climate Change in Burkina Faso (Burkina Faso);	Total funds for the 13 projects listed: US$35 million (the co-financing total amounts to US$60 million).

Table 5: Continued

Administered by	Name	Pledged (USD Millions)	Deposited (USD Millions)	Possible Interventions Related to Agriculture (Mitigation or Adaptation).	Resources Available for Agricultural Sector
				• Promoting Climate-Resilient Water Management and Agricultural Practices (Cambodia); • Building the Capacity of the Agriculture Sector in Congo, Dem. Rep. of the, to Plan for and Respond to the Additional Threats Posed by Climate Change on Food Production and Security (Congo, Dem. Rep. of the); • Integrating Climate Change Risk into Community-Level Livestock and Water Management in the Northwestern Lowlands (Eritrea); • Strengthening Resilience and Adaptive Capacity to Climate Change in Guinea-Bissau's Agrarian and Water Sectors (Guinea-Bissau); • Integrating Climate Resilience into Agricultural Production for Food Security in Rural Areas (Mali); • Support to the Adaptation of Vulnerable Agricultural Production Systems (Mauritania); • Integrating Adaptation to Climate Change into Agricultural Production and Food Security in Sierra Leone (Sierra Leone); • Integrating Climate Change Risks into the Agriculture and Health Sectors in Samoa (Samoa); • Implementing NAPA Priority Interventions to Build Resilience and Adaptive Capacity of the Agriculture Sector to Climate Change (Niger); • Implementing NAPA Priority Interventions to Build Resilience in the Agriculture and Water Sectors to the Adverse Impacts of Climate Change (Sudan); • Adaptation to the effects of drought and climate change in Agro-ecological Zone 1 and 2 in Zambia (Zambia)	
UNDP	MDG Achievement Fund – Environment and Climate Change thematic window	90	90	Enabling pastoral communities to adapt to climate change and restoring rangeland environments (Ethiopia).	US$4 million.

Table 5: Continued

Administered by	Name	Pledged (USD Millions)	Deposited (USD Millions)	Possible Interventions Related to Agriculture (Mitigation or Adaptation).	Resources Available for Agricultural Sector
World Bank	Pilot Program for Climate Resilience	208	0	No specific information available.	No specific information available.
World Bank	Scaling-up Renewable Energy Program for Low Income Countries	100	0	No specific information available.	No specific information available.
GEF	Special Climate Change Fund	107	94	• Coping with Drought and Climate Change (Ethiopia); • Adaptation to Climate Change in Arid Lands (KACCAL) (Kenya); • Mongolia Livestock Sector Adaptation Project (Mongolia); • Integrating Climate Change in Development Planning and Disaster Prevention to Increase Resilience of Agricultural and Water Sectors (Morocco); • Coping with Drought and Climate Change (Mozambique); • Rural Livelihoods Climate Change Adaptation Support Programme (Pakistan); • Coping with Drought and Climate Change (Zimbabwe).	Total funds for the 7 projects listed: US$18 million (the co-financing total amounts toUS$ 166 million).
World Bank	Strategic Climate Fund	1 585	0	No specific information available.	No specific information available.
GEF	Strategic Priority on Adaptation	50	50	• Adapting to Climate Change through the Improvement of Traditional Crops and Livestock Farming (Namibia); • Sustaining Agricultural Biodiversity in the Face of Climate Change (Tajikistan); • Adaptation to Climate Change Using Agro biodiversity Resources in the Rain Fed Highlands of Yemen (Yemen).	Total funds of the three projects listed: US$6.8 million.

Source: www.climatefundsupdate.org
Note: Based on funds registered and/or disbursed as of 20 August 2009; Co-financing relates to grants provided in addition to loans and/or private finance.

Table 6: Plans for the Agricultural Sector in NAPAs

Country	Adaptation Plan related to Agriculture (a) (b)	Indicative Project Cost in US$ (c)	Basis of Assumptions	Country-specific Source
Bangladesh	Promotion of research on drought, flood, and saline-tolerant varieties of crops. Promoting adaptation for coastal-crop agriculture to combat increased salinity. Adaptation in agricultural systems in areas prone to enhanced flash-flooding: North East and Central Regions.	5 050 000 6 550 000 6 550 000 18 150 000 (sum of all NAPA projects: 77 275 000) 23% of NAPA allocated to the Agricultural Sector.	A mean annual temperature increase of 2.4° C, a mean annual precipitation increase of 10% and a sea level rise of 88 cm, all by 2100.	NAPA Bangladesh, http://unfccc.int/resource/docs/napa/ban01.pdf
Cambodia	Promotion of household integrated farming. Development and improvement of community irrigation systems. Community-based agricultural soil conservation in Srae Ambel district, Koh Kong Province.	2 500 000 45 000 000 2 000 000 49 500 000 (sum of all NAPA projects: 128 850 000) 38% of NAPA allocated to the Agricultural Sector	Not specified.	Cambodia project list http://unfccc.int/files/adaptation/napas/application/pdf/06_camb_pp.pdf NAPA Cambodia http://unfccc.int/resource/docs/napa/khm01.pdf
Congo, Democratic Republic of the	The strengthening of agricultural production capacities: multiplication of improved seeds of corn, rice, and cassava.	5 658 760 5 658 760 (sum of all NAPA projects: 16 475 654) 34% of NAPA allocated to the Agricultural Sector	Not specified.	NAPA Congo, Democratic Republic of the: http://unfccc.int/resource/docs/napa/cod01.pdf
	Promotion of adaptation-oriented technologies. 1. Dissemination of soil conservation practices. 2. Intensification of bulrush millet crops in the northern region of Guinea. 3. Implementation of a system of early-warning climate forecasts to protect agricultural production.	300 000;350 000;150000	Not specified.	NAPA Guinea project list: http://unfccc.int/files/adaptation/application/pdf/napa_index_country.pdf NAPA Guinea: http://unfccc.int/resource/docs/napa/gin01f.pdf

Table 6: Continued

Country	Adaptation Plan related to Agriculture (a) (b)	Indicative Project Cost in US$ (c)	Basis of Assumptions	Country-specific Source
	Rehabilitation of the hydro-agricultural system of the plains and lowlands. 1. Implementation of irrigated rice cultivation in Moyenne and Haute Guinea.	300 000		
	Promotion of income-generating activities. 1. Intensification of small ruminant breeding. 2. Development and promotion of vegetable growing. 3. Implementation of a ranch for cane rats to prevent unsustainable hunting of wildlife	325 000;250 000;300 000		
		1 975 000 (sum of all NAPA projects: 8 025 000)		
		25% of NAPA allocated to the Agricultural Sector		
Guinea-Bissau	Capacity-building in protection of salt-water rice (mangrove) against high-tide invasion.	600 000	Temperature will rise 2%, rainfall will diminish by 11.7%, and the average seal level will rise 50cm (by 2100).	NAPA Guinea-Bissau http://unfccc.int/files/adaptation/napas/application/pdf/15_guineab_pp.pdf
	Promotion of small-scale irrigation in Geba and Corubal rivers project.	800 000		
	Rehabilitation of small perimeters of mangrove soils for rice growing in Tombali, Quinara, Bafata, and Oio project.	500 000		
	Support to production of a short-cycle animals project.	400 000		
		2 300 000 (sum of all NAPA projects: 7 200 000)		
		32% of NAPA allocated to the Agricultural Sector		
Madagascar	Support to the intensification of crop and livestock production (through material acquisition, input distribution, and development of income-generating activities and sectors at regional level).	270 000	Not specified.	NAPA Madagascar http://unfccc.int/resource/docs/napa/mdg01f.pdf
		270 000 (sum of all NAPA projects: 2 130 330)		
		13% of NAPA allocated to the Agricultural Sector		

Table 6: Continued

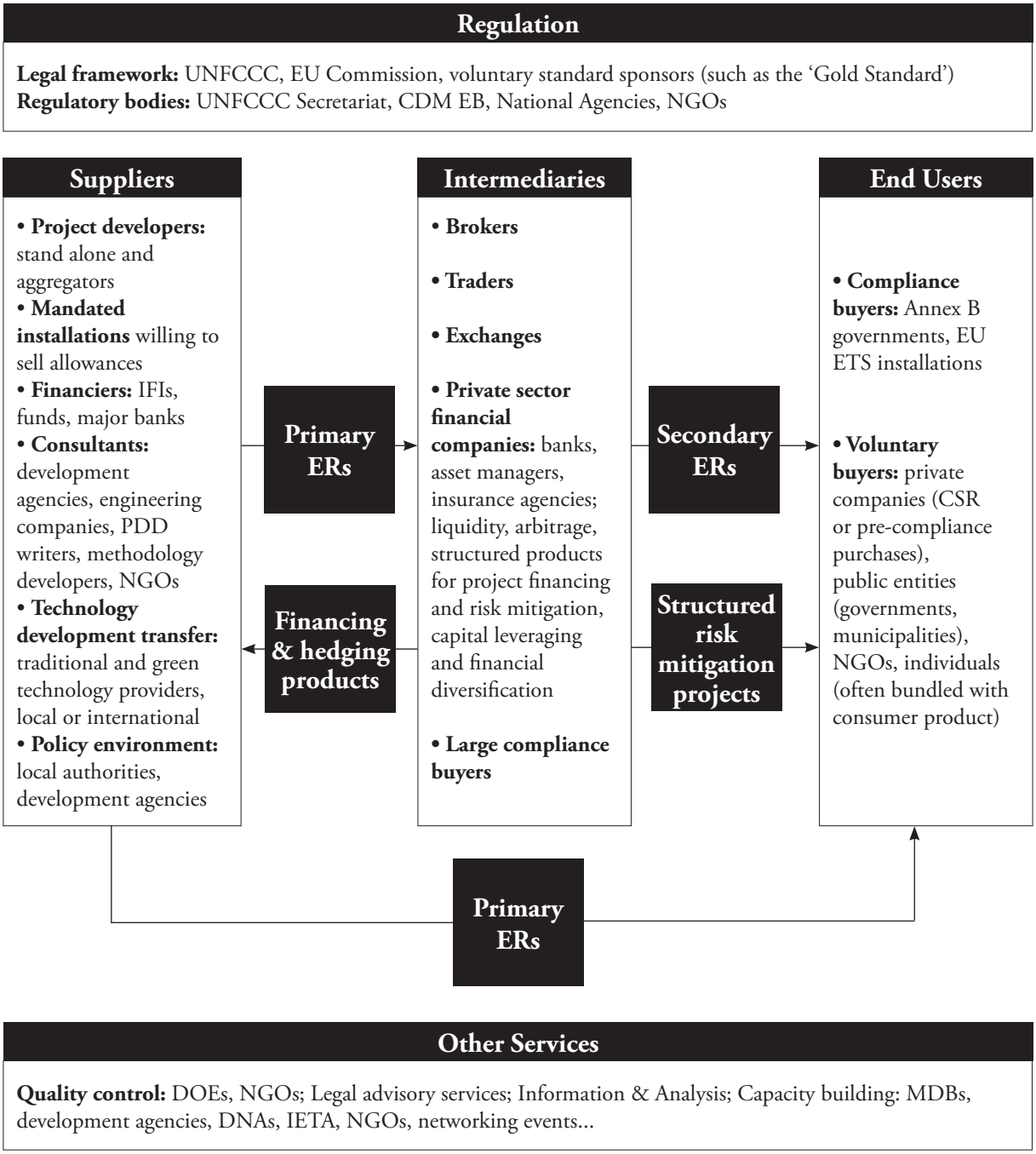
Country	Adaptation Plan related to Agriculture (a) (b)	Indicative Project Cost in US$ (c)	Basis of Assumptions	Country-specific Source
Malawi	Improving community resilience to climate change through the development of sustainable rural livelihoods.	4 500 000	Not specified.	NAPA Malawi http://unfccc.int/resource/docs/napa/mwi01.pdf
	Improving agricultural production under erratic rains and changing climatic conditions.	3 000 000		
		7 500 000 (sum of all NAPA projects: 22 930 000)		
		33% of NAPA allocated to the Agricultural Sector		
Senegal (d)	Implementation of agroforestry in northern region: 3rd Activity: Aiding fight against soil salinisation by planting halophyte species.	10 000;	Not specified.	NAPA Senegal http://unfccc.int/resource/docs/napa/sen01f.pdf
	Implementation of agroforestry in Bassin Arachidier region: 2nd Activity: Aiding fight against soil salinisation: 1. Recovering of 'tannes' by planting halophyte species. 2. Reforestation by planting *Tamarix*. 3. Restoration of dikes.	10 000;2 500 000; 1 000 000		
	Implementation of agroforestry in southern region: Tambacounda Kolda, Ziguinchor: 2nd Activity: Aiding fight against soil salinisation: 1. Planting halophyte species. 2. Reforestation by planting *Tamarix*. 3. Restoration of dikes.	10 000;2 500 000; 100 000		
	Implementation of agroforestry in southern region: Tambacounda, Kolda, Ziguinchor: 3rd Activity: Restoration of degraded soils: 1. Restoration of compost pits. 2. Buying carts.	54 000;90 000		
	Sustainable use of water-conservation promoting drip irrigation.	372 000		
		6 646 000 (sum of all NAPA projects: 43 182 000)		
		15% of NAPA allocated to the Agricultural Sector		

Table 6: Continued

Country	Adaptation Plan related to Agriculture (a) (b)	Indicative Project Cost in US$ (c)	Basis of Assumptions	Country-specific Source
Tanzania, United Republic of	Improving food security in drought-prone areas by promoting drought-prone tolerant crops.	8 500 000	Mean annual temperature will rise by 2º C–4ºC, precipitation change -15% up to +45%.	NAPA Tanzania http://unfccc.int/files/adaptation/napas/application/pdf/34_tanz_pp.pdf
		8 500 000 (sum of all NAPA projects: 17 170 000)		
		50% of NAPA allocated to the Agricultural Sector		
Zambia	Adaptation to the effects of drought in the context of climate change in the agro-ecological region of Zambia. Adaptation of land use practices (crops, fish, and livestock) in light of climate change.	3 000 000 1 200 000	Assumes temperature increase of 2ºC in the period of 2010-2070.	NAPA Zambia http://unfccc.int/resource/docs/napa/zmb01.pdf, Zambia project list http://unfccc.int/files/adaptation/application/pdf/napa_index_country.pdf
		4 200 000 (sum of all NAPA projects: 14 650 000)		
		29% of NAPA allocated to the Agricultural Sector		

(a) Agriculture refers to crop cultivation and livestock farming but excludes forestry and fishery. Even if projects concerning water management are considered agriculture-related in some NAPAs, this table only includes water issues if they refer to irrigation of cropland.
(b) The affected sectors can be found as listed per project and country under the UNFCCC NAPA country list: http://unfccc.int/files/adaptation/application/pdf/napa_index_country.pdf
(c) The figures were taken from the UNFCCC NAPA project database: http://unfccc.int/cooperation_support/least_developed_countries_portal/napa_project_database/items/4583.php
(d) For Senegal, Agroforestry carries out activities for the agricultural and forestry sector. So, the figures mentioned in this sector is the one allocated to activities linked with the agricultural sector.
Note: CER: Certified Emission Reduction credit; CIF: Climate Investment Fund; MDG: Millennium Development Goal; NAPA: National Adaptation Plan of Action.

Figure 1: Players and Institutions in the Carbon Market



Source: Adapted from Capoor and Ambrosi (2008:59)
Note: CDM EB: CDM Executive Board; CSR: Corporate Social Responsibility; DOE: Department of Energy; DNA: Designated National Authority; IETA: International Emissions Trading Association; IFI: International Financial Institution; MDB: Multilateral Development Bank; PDD: Project Design Document; UNFCCC: United Nations Framework Convention on Climate Change

About the Platform

In 2008 the International Food & Agricultural Trade Policy Council (IPC) and the International Centre for Trade and Sustainable Development (ICTSD) launched The ICTSD-IPC Platform on Climate Change, Agriculture and Trade: Promoting Policy Coherence. This interdisciplinary platform of climate change, agricultural and trade experts seeks to promote increased policy coherence to ensure effective climate change mitigation and adaptation, food security and a more open and equitable global food system. Publications include:

- International Climate Change Negotiations and Agriculture.
  Policy Brief No.1, May 2009

- Greenhouse Gas Reduction Policies and Agriculture: Implications for Production Incentives and International Trade Disciplines
  Issue Brief No.1, by D. Blandford and T. Josling, August 2009

- Climate Change and Developing Country Agriculture: An Overview of Expected Impacts, Adaptation and Mitigation Challenges, and Funding Requirements.
  Issue Brief No.2, by Jodie Keane, Sheila Page, Alpha Kergna, and Jane Kennan, December 2009.

- Carbon Standards Policies and Agricultural Trade from Developing Countries.
  Issue Brief No.3, by James Macgregor (forthcoming, December 2009).

- The Role of Trade in Food and Agricultural Products in Climate Change Adaptation Costs.
  Issue Brief No. 4, by Gerald Nelson, Amanda Palazzo, Claudia Ringler, Mark Rosegrant, Timothy Sulser, and Miroslav Batka (forthcoming, December 2009).

About the Organizations

The International Centre for Trade and Sustainable Development was established in Geneva in September 1996 to contribute to a better understanding of development and environment concerns in the context of international trade. As an independent nonprofit and non-governmental organization, ICTSD engages a broad range of actors in ongoing dialogue about trade and sustainable development. With a wide network of governmental, non-governmental and inter-governmental partners, ICTSD plays a unique systemic role as a provider of original, non-partisan reporting and facilitation services at the intersection of international trade and sustainable development. More information is available at www.ictsd.org.

The International Food & Agricultural Trade Policy Council promotes a more open and equitable global food system by pursuing pragmatic trade and development policies in food and agriculture to meet the world's growing needs. IPC convenes influential policymakers, agribusiness executives, farm leaders, and academics from developed and developing countries to clarify complex issues, build consensus, and advocate policies to decision-makers. More information on the organization and its membership can be found on our website: www.agritrade.org.