DIIS REPORT

LOW CARBON DEVELOPMENT AND POVERTY ALLEVIATION

OPTIONS FOR DEVELOPMENT COOPERATION IN ENERGY, AGRICULTURE AND FORESTRY

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.

Contents

Abbreviations **6**

Acknowledgements 7

Executive Summary **8**

1. Introduction **14**

2. Poverty, development and climate change in LDCs **16**
2.1 The dual challenge for LDCs 16
2.2 Mitigation as a possible development opportunity 18

3. Options in energy **24**
3.1 Energy, climate change and livelihoods 24
3.2 Practical mitigation options in energy 26

4. Options in agriculture **33**
4.1 Agriculture, climate change and livelihoods 33
4.2 Practical mitigation options in agriculture 35

5. Options in forestry **41**
5.1 Forests, climate change and livelihoods 41
5.2 Practical mitigation options under REDD 43

6. Implications for development cooperation **52**
6.1 Overall strategic recommendations 52
6.2 Recommendations for development cooperation in energy 55
6.3 Recommendations for development cooperation in agriculture 56
6.4 Recommendations for development cooperation in forestry 58

References **60**

Annex A	**International mechanisms for climate change mitigation**	**66**
Annex B	**Current financing for climate change mitigation in developing countries**	**71**
Annex C	**List of Least Developed Countries**	**78**
Annex D	**GHG Emissions for Danida Partner Countries and Denmark**	**79**
Annex E	**Rationales for scoring of options in energy**	**82**
Annex F	**Rationale for scoring of options in agriculture**	**86**
Annex G	**Rationale for scoring of options in forestry/REDD**	**89**
Annex H	**List of people consulted and workshop/seminar participants**	**92**
Annex I	**Selected institutions, networks and resource websites on low carbon development**	**96**
Annex J	**Emissions and GDP growth in selected countries**	**100**

Figures

Figure 1: Greenhouse Gas (GHG) Emissions by Sector in 2000 19
Figure 2: Indicative assessment of practical options in energy 31
Figure 3: Indicative assessment of three practical options for supporting agriculture in LDCs 39
Figure 4: Indicative assessment for LDCs of the potential strengths and weaknesses of the four practical forestry "options" as currently debated in REDD (see Annex G for detailed assessment) 48
Figure 5: Relationship between mitigation financing, development assistance and pro-poor low carbon development 53

Annexed

Figure A1: Annual volume of project-based carbon transactions 68
Figure A2: Voluntary market transactions by project location (2006) 69
Figure D1: GHG Emissions for Danida Partner Countries, Total in 2000 (Million metric tonnes) 79
Figure D2: GHG Emissions for Danida Partner Countries, Per Capita in 2000 (Million metric tonnes per capita) 80
Figure D3: GHG emissions from land-use change and forestry in selected Danida partner countries, cumulative for the period 1950-2000 81

Tables

Table 1: Forest area, forest loss and current carbon stocks 42
Table 2: Global land-use change emissions 42

Annexed

Table A1: Transactions of carbon credits by project type under the CDM and in the voluntary market 67
Table B1: Investment and financial flows required for 25% emissions reduction by 2030 71
Table B2: Estimated total available sources of public financing for innovation of mitigation technologies and practices (globally, as of November 2008) 73
Table B3: Major multilateral funding sources for mitigation and adaptation 74
Table B4: Major bilateral funding sources for climate change mitigation and adaptation 75

Abbreviations

CBF	Community Based Forestry
CDM	Clean Development Mechanism
FCPC	Forest Carbon Partnership Facility
GDP	Gross Domestic Product
GEF	Global Environment Facility
GHG	Greenhouse Gasses
GNI	Gross National Income
IPCC	International Panel on Climate Change
LDC	Least Developed Country (see Annex F for complete list)
MDG	Millennium Development Goals
PES	Payment for Ecosystem Services
PFM	Participatory Forest Management
REDD	Reduced Emissions from Deforestation and Degradation
SME	Small and Medium Enterprise
tCO_2	Tonnes of CO_2
UNFCCC	United Nations Framework Convention on Climate Change
UNREDD	UN facility for addressing REDD

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Executive Summary

This report presents the main findings from a desk study on "Climate change mitigation and poverty reduction in developing countries: opportunities for development cooperation" undertaken by the Danish Institute for International Studies with funding from the Danish Ministry of Foreign Affairs. The study identifies practical options for combining low carbon development with poverty reduction and economic growth in Least Developed Countries (LDCs), with a focus on energy, agriculture and forestry.

(i) Climate change mitigation as a development opportunity

In the years to come, LDCs will face the dual challenge of addressing climate change while at the same time continuing their efforts to alleviate poverty and foster economic development. The enormity of this task, and the fact that LDCs currently contribute only 6% of global emissions, often leads to the conclusion that LDCs should leave climate change mitigation to the wealthier countries, and instead focus on following the conventional economic development path. However, mitigation efforts in themselves do not always constitute an economic burden but may entail considerable economic and technological benefits for LDCs, including:

- *Efficiency savings*, e.g. improved energy efficiency, with associated reduced costs; more efficient land and forest management practices; reduced pollution, improved health etc.
- *Reduced economic dependency:* e.g. reducing future dependencies on fossil fuel imports, replacing imports of expensive energy technologies and knowledge with low-cost appropriate technologies.
- *New economic opportunities*, e.g. the development of new business opportunities and industries, benefits from carbon markets, employment creation, improved local incomes from productive agriculture and forest use.
- *Adaptation benefits*, e.g. mitigation efforts that also support adaptation such as providing a basis for coping strategies among the poor in response to inevitable climate change impacts.

For the poor, the benefits of a low carbon development process may strengthen livelihood assets in a number of ways, including (i) improved or sustained income

opportunities, e.g. alternative income generation and direct labour/employment (financial assets), (ii) improved or sustained ecosystem services, from e.g. soils, grasslands, water and forest resources (natural assets), and (iii) improved human resources through cleaner natural and working environments and thereby improved health (human assets).

Low carbon development thus potentially provides a number of opportunities for LDCs in both the short and longer terms. Significantly, however, taking a low carbon development path in LDCs does not imply that the current emission levels of LDCs should be reduced in absolute terms. While there may be a justification for actual emissions reductions in areas where LDCs do in fact contribute to global emissions (e.g. forestry), it is neither realistic nor morally defensible to expect that the currently very limited overall emission rates within LDCs should be reduced from their current levels in absolute terms. What is desirable, however, is if, for example, energy consumption in LDCs can be developed through a means that is low on emissions while still furthering poverty alleviation and economic growth. In this context, the report identifies key options within the energy, agriculture and forest sectors, and undertakes an indicative assessment of these in relation to their scope for poverty alleviation, emissions reductions and economic growth, as well as local environmental benefits, investments costs and maturity of technology.

(ii) Options and recommendations in energy

Access to clean and reliable energy plays a vital role in many aspects of poverty alleviation and sustainable development in general and is widely seen as a prerequisite for achieving the Millennium Development Goals. Globally, the energy sector is responsible for around two thirds of total GHG emissions, but in LDCs, energy production and consumption is currently responsible for a much smaller proportion of GHG emissions (6% in average). Addressing energy issues in LDCs is therefore a matter of longer-term planning. If current development efforts eventually succeed in LDCs, they will not continue to be small energy consumers, and dependence on fossil fuels will become an increasing burden for the economies of most such countries. Therefore, a move towards more renewable energy will benefit both the environment and the long-term stability of these economies. Such a path can be built on already proven and affordable energy technologies for cooking, mechanical power, electricity generation and transport. On this basis, it is recommended that development cooperation should:

- Assist in developing and optimizing local low carbon energy delivery mechanisms suited to local needs for clean and efficient cooking, lighting, education, health care and power for productive tools in agriculture or other small enterprises.
- Integrate and package local energy development with broader support to community development activities, such as agricultural extension, education, health care and services for small-scale enterprise development.
- Support development plans which allow for the short- and medium-term development of isolated energy in dispersed rural settlements which will not be connected to the main electricity grid within the coming decades.
- Promote the development of criteria for socially and environmentally responsible energy development, with a particular focus on low carbon energy-development options that are characterized by being directly or indirectly harmful to the livelihood options of poor people.

(iii) Options and recommendations in agriculture

From a climate change mitigation perspective, there are strong reasons to focus upon agriculture in LDCs, a sector with significant potential for enhancing carbon sequestration. Agriculture is known to contribute to climate change in five major ways, and agricultural production is estimated to be responsible for 28% of global GHG emissions, including inputs counted and produced in other sectors. As more knowledge becomes available, for instance regarding the disruptive effects of biofuels and pesticides, agriculture's actual contribution may turn out to be significantly higher. Options for climate change mitigation in agriculture include (i) sustaining and enhancing soil carbon storage capacity and thereby also water-holding capacity; (ii) reducing emissions from pesticide application; (iii) integration of crop and animal production; and (iv) reducing the production, transport and use of synthetic nitrogen fertilizers. The following recommendations are made for development cooperation:

- Combine an emphasis on practical options with a macro-focus and an integrated approach. In most cases, isolated climate-oriented programs and "add-on" policies will not be enough. There is also a need to address the macro-economic market conditions for agriculture, and to ensure that policies in other sectors (e.g. industry and environment) are supportive of low carbon agriculture.
- Develop institutional frameworks for pro-poor and low carbon multifunctional agriculture. This includes the capacity to introduce environmental policy instruments, taxation and environmental impact assessment of private and public agricultural investments.

- Provide better options for soil management to enhance the carbon storage capacity and thereby also the water-holding capacity of the soil, including research and capacity development among extension staff. This will not only help on the mitigation side, but will also provide important adaptation benefits such as enhancing water efficiency and conservation.
- Improve frameworks for biological pest control. An emphasis on biological pest management is preferable as a means of both enhancing productivity and reducing emissions.
- Support the capacity and reduce the costs of the organic certification of agricultural production and stimulate the demand for organic certification.

(iv) Options and recommendations in forestry

Global emissions from deforestation and land-use change are estimated to account for 18% of total GHG emissions. LDCs are responsible for some 20% of this, making land-use change and forestry the only truly significant sources of emissions from LDCs in global terms. Current debates over forestry and climate change mitigation center on the development of a global scheme for Reduced Emissions from Deforestation and Degradation (REDD) under a post-2012 UNFCCC regime. Under REDD, countries would be financially compensated for reducing emissions from deforestation and degradation. Such a mechanism will potentially direct significant sums towards LDCs with forest resources, but only if they are equipped to tackle the drivers of deforestation and to address the required capacity needs and upfront investment costs. For the poor, REDD holds good potential but also incorporates significant risks. Forests constitute vital assets in the livelihoods of both Indigenous Peoples and a large proportion of other rural populations in LDCs, and with the wrong approaches, REDD would pose a serious threat to their rights and welfare. On this basis, it is recommended that development cooperation should:

- Expand the scope of current REDD preparatory activities, to increase the emphasis on addressing the actual drivers of deforestation through cross-sectoral policy reform.
- Build pro-poor needs and safeguards into national forest-related policies and plans. This includes ensuring local forest-user rights within and beyond REDD, and supporting representation of the poor in forest governance mechanisms.
- Promote sustainable community-led forest use in the REDD context. This involves support to the "REDD Plus" approach, which rewards positive changes in forest area and carbon density.
- Support pro-poor approaches in international REDD negotiations, including

the development of mechanisms that incorporate social standards and avoid biases against LDCs.

(v) Overall strategic recommendations

In order to address the above options and recommendations, it will be vital to adopt approaches that follow several basic principles:

Ensure full LDC ownership and incentives in pro-poor low carbon development. The notion of low carbon development is gaining an increasing foothold among policy-makers in developing countries. Nevertheless, the issue remains controversial in a context where support to pro-poor low carbon development may easily be perceived as imposing constraints on national economic development. Development cooperation on these issues must therefore ensure that full national and local ownership and representation is de facto at the forefront of any intervention.

Ensure that poverty concerns "outside" climate change are not undermined. It is crucial to prevent pro-poor climate change mitigation from becoming the only target for poverty-oriented development assistance. This would risk diverting funds away from pro-poor interventions in the wide range of other "conventional" fields of pro-poor development cooperation. Development assistance that is in principle targeted at poverty alleviation should remain so.

Support options that will have an impact regardless of international climate financing. Past experience suggests that there is a risk that LDCs and/or their poor may not benefit substantially from global mitigation and carbon financing mechanisms. It is therefore recommended that development assistance to pro-poor low carbon development is focused on options that will be beneficial to poverty alleviation, even if global carbon financing fails to reach the poorest.

Exploit options for synergies between adaptation and mitigation. The recent tendency towards a certain polarization between mitigation and adaptation efforts has meant that little attention has been given to the options for addressing both at the same time. However, a number of the mitigation options discussed in this report will also support adaptation efforts, and vice versa. Greater attention is therefore needed on linking adaptation and mitigation efforts for the benefit of the poor.

Strengthen local levels. A number of the options discussed in this report require national policy reforms and capacity development. However, if such policy frame-

works are to have a real effect on the ground, they also require greater attention to be paid to developing local institutions and capacities for supporting low carbon development. This does not imply a series of stand-alone projects, but concerted national efforts to enhance local frameworks for low carbon development as a means of reducing vulnerability and enhancing livelihoods.

1. Introduction

This report presents the main findings of a desk study on "Climate change mitigation and poverty reduction in developing countries: opportunities for development cooperation", undertaken by the Danish Institute for International Studies with funding from the Danish Ministry of Foreign Affairs. The main objective of the study is to identify options for combining low carbon development pathways with poverty reduction and economic growth in the Least Developed Countries (LDCs), as part of efforts to target development assistance to address both poverty and global warming problems. The report discusses the pros and cons of climate change mitigation measures that also support poverty alleviation and economic development within the energy, agriculture and forestry sectors. It concludes with a series of recommendations for development cooperation.

As a desk study, the report draws primarily on a review of the emerging literature on the topic (general overviews, case studies and research reports). This has been supplemented by a workshop with invited resource persons from the Danish resource base, and a full-day public seminar with presenters from Denmark and developing countries. Individual interviews have been held with selected practitioners and researchers in Denmark and the UK. Finally the authors have attended relevant workshops and conferences during preparation of the report. The authors would like to thank all individuals and organisations who provided valuable insights, assistance and time to the process.

Climate change adaptation and mitigation have quickly become standard terms in the development vocabulary, and a few clarifications of the terminology used in this report are therefore in order. The IPCC defines adaptation and mitigation as follows:

Adaptation refers to initiatives and measures to reduce the vulnerability of natural and human systems against actual or expected climate change effects.

Mitigation refers to technological change and substitution that reduces resource inputs and emissions per unit of output.

Adaptation efforts thus address the already ongoing and unavoidable impacts of climate change, either in anticipation of such impacts, or as a reaction to impacts that

have already occurred, while Mitigation measures seek to reduce greenhouse gas (GHG) emissions and/or develop or enhance the capacity of carbon sinks.

In this report, ***Low Carbon Development*** refers to an economic development process which minimizes the output of GHG emissions into the atmosphere. In addition to such a development process, there may then be a number of positive effects on poverty alleviation, although importantly it should not be assumed that these come automatically from a low carbon development process.

Finally the term ***Least Developed Countries*** (LDCs) is used here in accordance with the UN definition as a country with (i) low income levels (GNI per capita below USD 750 over three years), (ii) exhibiting human resource weaknesses (based on health, education and literacy indicators) and (iii) economic vulnerability (including agricultural production, exports, disasters and various other factors). A list of current LDCs is provided in Annex C.

2. Poverty, development and climate change in LDCs

2.1 The dual challenge for LDCs

Current development trends in LDCs

Recent years have seen positive advances in some LDCs towards achieving parts of the Millennium Development Goals. Primary school enrolment has increased in several countries, access to water and sanitation is improving in some countries, and efforts against malaria are showing results in some LDCs. Nevertheless, these positive developments are in most cases unevenly spread across LDCs, and the share of LDCs in overall development towards the MDGs remains limited. For instance, while the global number of people living on less than a dollar a day decreased from 28% to 19% during the period 1990-2004, poverty rates in Sub-Saharan Africa only decreased from 45% to 44% during this time. Of the 46 LDCs, 18 had per capita growth rates of less than 1% during this period (UN2008a, UN2008b).

Economic development and poverty alleviation in LDCs is now also being constrained by a number of new global developments. According to the 2008 MDG Report, higher food prices may increase the depth of poverty for some 100 million people, many of whom are found in LDCs (UN 2008a). The same report concludes that, of the 750 million people living in LDCs, those living in rural areas are at a particular disadvantage as a result of the neglected development of agriculture and public services in rural areas. HIV and limited opportunities for off-farm employment are further obstacles. Distressingly, recent advances in the calculation of poverty rates suggest that these may be higher than previously estimated (op. Cit.). Even where development is positive in LDCs, it is far from always evenly distributed *within* countries, resulting in a "bottom billion" of rural and urban poor who so far have had only limited benefits from economic development.

A recent MDG Task Force Report concluded that "There is a large delivery gap in meeting commitments towards the MDG target of addressing the special needs of the least developed countries" (UN 2008b). In response to this, MDG reports and the UN Brussels Declaration for Least Developed Countries call for increased assistance to an economic development process in LDCs that emphasizes pro-poor economic development at local levels in rural areas.

The impacts of climate change on LDCs

In addition to these developments, climate change is expected to hit the LDCs hardest as a result of their high degrees of dependence on natural resources and their limited resources and institutional capacity for addressing large-scale adaptation. The impacts of climate change will vary from region to region and country to country, and some new opportunities may emerge as a result of, for example, increased rainfall or warmer temperatures in some areas. Nevertheless, climate change impacts are predicted to be largely negative in most LDCs, especially those located at low latitudes.

The IPCC estimates that 75 to 250 million people will be exposed to increased water stress by 2020 as a result of climate change. Coupled with the growing demand for water, this will seriously affect development and possibly increase conflicts over water. Changes in the climate are also projected to affect agricultural production severely. In the margins of arid and semi-arid areas in particular, we can expect to see a decrease in the length of growing seasons, yield potential and total area suitable for production. This would further affect food security and malnutrition in these areas. By 2020, yields from rain-fed agriculture could be reduced by up to 50 percent in some countries in Africa (IPCC 2007). Reduced fisheries resources in large lakes will also have a negative effect on local food supplies. Towards the end of the 21st century, sea-level rises are predicted to severely affect low-lying coastal areas with large populations.

These predictions not only put at risk the economic development and poverty reduction achieved so far in developing countries, they may also erode further the basis of local livelihoods and thereby contribute to increased rural and urban poverty. In such situations, those who are already among the poorest are particularly fragile, as they may lack the means to diversify or otherwise minimize risks from climate change. It will also tap national budgets heavily as costs to address impacts and adaptation measures increase.[1]

1 See OECD (2009) and Commission on Climate Change and Development (2009) for elaboration of how development cooperation can help address the challenges of adaptation.

2.2 Mitigation as a possible development opportunity

LDCs thus face an enormous double challenge in the years to come. Not only must they continue their uphill struggle for overall economic growth and poverty reduction, they will also have to wrestle with the global climate changes that are threatening exactly these countries the most. The enormity of this task often leads to the conclusion that low-income countries should leave low carbon development to the wealthier countries and instead focus on following the conventional economic development path. However, there is now a growing attention to the fact that a low carbon development process may in fact contribute to poverty alleviation and economic development in these countries. This section briefly discusses the emissions from LDCs and the potential benefits of taking a low carbon development path. Annex B provides an overview of the current main financing mechanisms for climate change mitigation, including the CDM mechanism and multilateral and bilateral funding within the specific sectors.

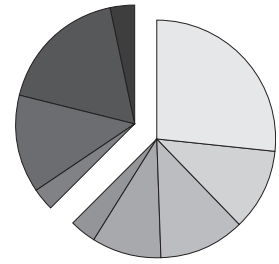
LDCs and GHG emissions

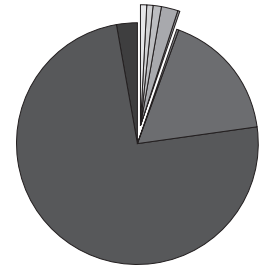
According to data from the World Resources Institute, energy production and consumption are the main causes of global GHG emissions on the global scale, responsible for an estimated 63% of global greenhouse gas (GHG) emissions.[2] Not surprisingly, therefore, increasing the efficiency of energy use and the reliance on renewable energy sources has been the main focus for climate change mitigation efforts at the global level.

The picture for LDCs differs significantly from these global averages. In LDCs, energy production and consumption are responsible for only 6% of total GHG emissions, while land-use change and forestry is responsible for 74% of GHG emissions. Figure 1 shows the composition of emissions by sector for LDCs. Annex D shows per capita emissions from Danida's partner countries and Denmark.

2 If emissions stemming from land-use change and forestry are excluded from total GHG emissions, energy production and consumption are estimated to be responsible for 76% of total emissions.

Figure 1: Greenhouse Gas (GHG) Emissions by Sector in 2000, World and Least Developed Countries Million tonnes CO_2 equivalents (CO_2, CH_4, N_2O, PFCs, HFCs, SF6)

World			
Sector	**$MtCO_2$**	**%**	
Energy	26,980.4	62.7	
Electricity & Heat	11,581.5	26.9	
Manufacturing & Construction	4,748.4	11.0	
Transportation	5,089.0	11.8	
Other Fuel Combustion	3,964.1	9.2	
Fugitive Emissions [1]	1,597.4	3.7	
Industrial Processes	1,369.4	3.2	
Agriculture	5,729.3	13.3	
Land-Use Change & Forestry	7,618.6	17.7	
Waste	1,360.5	3.2	
Total	**43,058.3**		

Least Developed Countries			
Sector	**MtCO2**	**%**	
Energy	116.7	5.6	
Electricity & Heat	21.1	1.0	
Manufacturing & Construction	18.8	0.9	
Transportation	23.5	1.1	
Other Fuel Combustion	42.4	2.0	
Fugitive Emissions [1]	11.0	0.5	
Industrial Processes [2]	6.5	0.3	
Agriculture	354.5	17.1	
Land-Use Change & Forestry	1,543.8	74.4	
Waste	52.1	2.5	
Total	**2,073.6**		

[1] N_2O data not available. [2] CH_4 data not available.
Citation: Climate Analysis Indicators Tool (CAIT) Version 5.0. (Washington, DC: World Resources Institute, 2008).

Currently and in the short- to medium terms, LDC contributions to global emissions are thus relatively limited, with the exception of emissions from deforestation and degradation and certain agricultural practices. However in the longer term this picture may change. The emissions histories of countries like Egypt, Thailand and Vietnam, which have all experienced significant economic growth in recent decades, indicate a corresponding growth in GHG emissions. Annex J provides illustrations of the growth in emissions and GDP in these three countries. Thailand, for instance, quadrupled its GDP from 1980 to 2005, while its CO_2 emissions from energy rose six-fold during the same period. A similar trend is evident in the data for Egypt and Vietnam. Annex J also indicates how a similar parallel growth of GDP and GHG emissions also appears to have taken place in low-income countries such as Nicaragua, as well as in actual Least Developed Countries such as Tanzania and Nepal, although the extent of growth these countries is, of course, far smaller.

This apparent connection between growth in GDP and growth in emissions suggests that, if development efforts in LDCs succeed and economies grow in the future, emissions will most likely follow. If this is addressed already now through a low carbon development process, LDCs may save and harvest significant economic benefits, as discussed in the following.

Mitigation as a development opportunity

In most LDCs both national action plans and donor assistance have so far focussed mainly on options for adaptation. Thus, less than one percent of all CDM projects to date have been implemented in LDCs (42 out of 4660 projects). To some extent, this has been in line with the principles of "common but differentiated responsibilities" in the Kyoto protocol, which places a heavier burden on developed countries in climate change mitigation in recognition of the far larger share of total emissions carried by those countries. At the same time, the urgent nature of climate change impacts in many developing countries calls for immediate adaptation measures. Thus, mitigation concerns have tended to be seen as a potential economic burden rather than an option for developing countries, and for LDCs in particular.

However, mitigation efforts in themselves do not always constitute an economic burden, but may entail economic as well as technological benefits, in addition to serving to offset future climate change. Potential opportunities can be grouped into four overall categories:

i. *Efficiency savings*, e.g. improved energy efficiency, with associated reduced costs, more efficient land- and forest-management practices, and opportunities for reducing pollution from currently inefficient technologies, leading to improved health, etc.
ii. *Reduced economic dependency:* e.g. reducing future dependencies on fossil fuel imports, replacing imports of expensive energy technologies and energy knowledge with low-cost appropriate technologies etc.
iii. *New economic opportunities*, e.g. the development of new business opportunities and industries, the diversification of energy bases with reduced dependence on single energy sources, benefits from carbon markets etc. Also new income opportunities at the individual level, including employment creation, improved local incomes from forest management schemes and incomes from more sustainable agricultural practices.
iv. *Adaptation benefits*, e.g. mitigation efforts that also support adaptation such as providing a basis for coping strategies among the poor in response to inevitable climate change impacts (e.g. sustainable forest management)

These different benefits may come *directly* from mitigation activities, such as the savings on more efficient and/or cheaper energy sources, or they may come as indirect knock-on effects of mitigation practices, such as improved environmental services from forest management (e.g. water conservation).

Apart from these more immediate opportunities, a low carbon development path in LDCs might also help offset the risk of such countries becoming locked in "adaptation mode" and thereby losing further ground in the current world order of economic development and skewed terms of trade. Currently, and despite numerous barriers, technological development and regulation in the North is making not insignificant advances in increasing energy efficiency in different sectors of society by drawing on renewable energy, improved waste management, etc. By maintaining a sole focus on adaptation measures, the risk is that LDCs will in the long run lose out on such developments, or will remain entirely dependent on the North for their transfer and implementation in LDCs.

In saying this, however, it is also crucial to recognize that a low carbon development path does not imply that LDC emission rates should be reduced across all sectors in LDCs. While this may be possible within certain specific sectors (including for-

estry, where emissions are currently relatively high), it is neither realistic nor morally defensible to expect that the currently very limited emission rates from, for example, electricity generation in LDCs should actually be reduced. What is desirable, however, is if the power sector in LDCs can be developed through a means that is low on emissions while still promoting poverty alleviation and national development.

Low carbon development and poverty reduction

The overall economic benefits from climate change mitigation in developing countries are not automatically linked to poverty reduction. The relationship between poverty reduction and climate change mitigation in developing countries can take several forms:

Direct benefits. The most immediate benefits for the poor of low carbon development efforts will come from initiatives that directly support their livelihoods, that is, efforts and mechanisms that directly increase the natural, human or financial assets of the rural as well as the urban poor (e.g. through rural energy supply, waste treatment, reduced reliance on risky chemical substances, etc.).

Indirect benefits. Benefits to national economies resulting from low carbon development strategies may support poverty reduction indirectly. For instance, incomes from international carbon trading markets may increase the national budgets available for rural development programmes. Likewise, the development of more efficient and participatory governance mechanisms related to, for example, community-based forest conservation can produce significant indirect benefits for the poor in terms of political empowerment and leverage.

No benefits or negative effects. Not all economic opportunities will benefit the poor, and some otherwise sound low carbon development efforts may even increase socioeconomic marginalisation, or create benefits for some groups of poor but disadvantage others. For instance, poorly planned hydropower development may provide cheap and climate-friendly energy for urban populations, but could impact negatively on the livelihoods of rural populations in the area in question.

Although indirect benefits from climate change mitigation are valuable and important in themselves, this study primarily focuses on the more direct benefits for the poor, as well as the potential negative effects. In practice, we examine climate change mitigation measures and mechanisms that enhance the assets of the poor through:

Improved or sustained income opportunities, including alternative income generation and direct labour/employment (economic assets).

Improved or sustained ecosystem services, for example, from soils, grasslands, water and forest resources (natural assets).

Improved human resources, including through the reduction of health/pollution issues.

Below we discuss these aspects in relation to three selected themes/sectors, namely energy, agriculture and forestry. These particular areas have been identified on the basis of their current and future significance in terms of economic development and emissions, as well as the potentials within them to improve the natural, human or financial assets of the poor. The selection of these particular sectors does not imply that other areas (e.g. waste management, industrial technologies etc.) are of no relevance, and some are touched briefly upon in relation to the areas that are the subject of this report.

3. Options in Energy

3.1 Energy, climate change and livelihoods

The role of energy in local livelihoods

Access to energy services plays a vital role in many aspects of poverty alleviation and sustainable development in general. Although energy is not mentioned explicitly in any of the Millennium Development Goals, access to clean and reliable energy is a prerequisite for the achievement of most of them, as described in the text box below (Modi et al. 2005, DFID 2002, GNESD 2007a).

How access to energy is essential for reaching the MDGs

To halve extreme poverty. Access to energy services facilitates economic development such as micro-enterprises, livelihood activities beyond daylight hours and locally owned businesses, which will create employment and assist in bridging the 'digital divide'.

To reduce hunger and improve access to safe drinking water. Energy services can improve access to pumped drinking water, and 95% of staple foods need cooking before they can be eaten.

To reduce child and maternal mortality, and reduce disease. Energy is a key component of a functioning health system, for example, lighting operating theatres, refrigeration of vaccines and other medicines, sterilization of equipment and transport to health clinics. Clean and efficient cooking fuels and stoves can significantly improve the health of women and children especially by reducing smoke-related respiratory diseases.

To achieve universal primary education, and to promote gender equality and the empowerment of women. Energy services reduce the time spent by women and children (especially girls) on basic survival activities (gathering firewood, fletching water, cooking etc.); lighting permits home study, increases security, and enables the use of educational media and communication in schools, including information and communication technologies (ICTs).

Environmental sustainability. Improved energy efficiency and use of cleaner alternatives can help to achieve a sustainable use of natural resources, as well as reducing emissions, which protects the local and global environments.

Source: adapted from DFID 2002

Despite the important links between energy and livelihoods, there has in the past decade been a relative lack of attention to the role of energy for development in the

LDCs in both national policies and in development assistance (possibly as a result of the omission of energy from the MDGs). Energy services in rural areas have frequently received only limited attention in national policies and programs, and there has been little emphasis on tracking poor people's access to such services. Energy-sector reforms often fail to incorporate rural electrification into the overall national strategy for improving the electricity sector. In Kenya and Uganda, for instance, even if the targets set in national policies are realised, it will still leave more than 80% of the rural population with no electrification within the next decade (Karakesi 2004). There is now a tendency towards a renewed attention to energy in both national poverty-reduction policies and the donor community, and the links to low carbon development in this context will be obvious to explore.[3]

Energy and climate change

Energy consumption is tightly linked to economic development. Modern industrialisation and economic development over the last century has been built on the ability to produce and distribute energy on a large scale, and on access to cheap and abundant fossil fuels (Larsen et al. 2008). Globally, the energy sector is responsible for around two thirds of total GHG emissions, and it has therefore been the main focus for climate change mitigation efforts globally.

In LDCs, energy production and consumption is currently responsible for a much smaller proportion of GHG emissions (6%; see Figure 1). However, adopting a long-term perspective, a number of issues become apparent:

- First, and as argued above, if current development efforts eventually succeed in LDCs, energy consumption will increase substantially in these countries. If they were to follow the development process in middle-income countries, in twenty to thirty years, LDCs would be faced with a significantly larger proportion of global GHG emissions from energy production and consumption than is currently the case.
- Secondly, and in connection with this, the current dependence on fossil fuels will become an increasing burden for the economies of most LDCs which rely on imported oil, gas and coal, or whose domestic reserves will not last long. Increasing the proportion of renewable energy at an early stage of energy sector de-

3 The EU has provided €200 m. to energy projects in Africa through its Energy Initiative since 2005, and with the recent agreement on an Africa-EU Energy Partnership, this support will likely continue. Other donors, both multilateral and bilateral, are giving renewed priority to energy development, including the World Bank, UNDP, UNIDO and German GTZ. (Larsen et al. 2008).

velopment will help to reduce this dependence and benefit both energy security and national economies in the long run.
- Thirdly, the development of a global carbon market provides opportunities for LDCs to obtain financial support for introducing low carbon options in the energy sector.

With this in mind, this section will look at the pro-poor options and constraints for low carbon energy development in the LDCs.

3.2 Practical mitigation options in energy

In the following, low carbon options are discussed in relation to electricity production in general, as well as three key services relevant to poverty alleviation and economic development, namely (i) energy for cooking, (ii) motive power, and (iii) energy for transport.

Overall options in electricity production

Electricity is critical for a range of basic needs and social services in development, including health treatment, education and communication. It also powers machines used in activities that may generate employment or provide direct income for the poor. The availability of electricity in an area will in many cases also help attract educated workers who can provide highly needed social services (such as doctors, teachers and agricultural extension workers). Most LDCs currently retain an emphasis on developing large-scale electricity production based on fossil fuels (mainly coal), but alternative options are increasingly being explored:

Large-scale *hydropower* is continuously being developed in many areas, although with less speed in African countries than in Southeast Asia (e.g. Laos and Cambodia). In the latter region, wealthier neighbouring countries (mainly Thailand and China) are investing to obtain supplies of cheap energy, while at the same time externalising the environmental and social consequences of the dam constructions. Hydropower resources in Africa are considerable and still widely underdeveloped. With much lower population densities in Africa than in Southeast Asia, the negative social consequences of hydropower development may be easier to avoid in some African settings, although environmental effects (and thereby also downstream social impacts) will require rigorous attention. Importantly, it should be noted that the actual emissions-reduction potential of large-scale hydropower production is disputed (see e.g. Fearnside 2002 versus Rosa et al. 2004). Some research suggests

that emissions from large-scale hydropower may in some cases be similar to or even higher than electricity produced from fossil fuels.[4] Under some circumstances, large-scale hydropower may therefore be less attractive as a low carbon option.

Cogeneration from *biomass waste* from, for example, sugar factories or sawmills is increasingly used to produce electricity, both for the factories' own use and for selling to the main grid when a surplus is produced. This side business can potentially be very profitable. In some sugar factories, incomes from the sale of electricity may actually exceed the income from sugar. Cogeneration from the sugar industry has helped Mauritius to become the first country in Africa to have achieved 100% electrification.

Other renewable energy sources are not yet being explored on the larger scale, frequently because initial investment costs are judged to be too high and the potential (e.g. wind) is sometimes localized rather than nationwide. At the local level, many micro-projects currently explore the usefulness of small-scale renewables. But the main source of off-the-grid power is still diesel, as this is still the most cost-effective supply of energy for local mini-grids or dispersed settlements. However, with increasing prices for fossil fuels and the further development of renewable resources, alternative energy sources will become increasingly competitive financially.

Large- and small-scale options

How electricity is best provided depends very much on the type of settlement and distribution infrastructure available. In general, electricity can be provided at three levels:

- Generated on a large scale at central power plants and distributed through a national grid with connections to local areas
- Generated in de-centralised smaller scale systems and distributed through local mini-grids
- Generated on site in individual systems

Electricity production on the larger scale and distribution through nationwide grids is at the core of most LDC energy development strategies. In many respects, the development of large-scale low carbon energy production has good potential to limit future GHG emissions from LDCs, and will potentially benefit their general eco-

4 This is particularly so when dams are created by flooding large areas of forested land. This leads to the submersion of large quantities of biomass, and the anaerobic decomposition of this organic material creates large quantities of methane, which will eventually be released into the atmosphere (Fearnside 2002).

nomic growth. However, in the short and medium terms it has very limited potential for benefiting the poor, especially those living in dispersed settlements away from the central grid. In some cases it may even have direct negative effects on the poor (e.g. negative downstream impacts of large-scale hydropower development). Further development of large-scale low carbon options such as hydropower development in Africa will therefore require careful assessments of the social and environmental impacts, as well as meticulous analysis of the de facto emissions-reduction potential. It also requires integrated planning and implementation at the local, regional and national levels to ensure sound energy management, as well as avoid the externalisation of social and environmental costs by some stakeholders and countries. In particular, the poverty implications of all low carbon investments should be carefully scrutinised, especially if development cooperation funds (with poverty alleviation as their main objective) are used to plan or implement such initiatives.

A large proportion of poor people live in areas where access to the electricity grid is not available, and local mini-grids or individual systems are therefore often the only solution. This means higher prices per unit of electricity, which therefore also limits the use of electricity to the more urgent needs. In rural communities outside the reach of the central electricity grid, there are potentially significant pro-poor livelihood benefits from electricity production in small-scale individual systems. Coupled with the use of low carbon technologies (such as small-scale hydro, wind power, solar PV, biofuels or the cogeneration of biomass waste), such de-centralised systems with mini-grids or individual systems are very suitable for inclusion in a pro-poor low carbon development strategy. That said, the relatively high initial investments needed for renewable energy technologies, compared to a conventional diesel generator, make it necessary to identify suitable financing mechanisms for these technologies in the short run.

In the following sections, low carbon options other than for electricity production will be discussed in relation to energy services for cooking, motive power and transportation.

Energy for cooking

Cooking is the major energy consumer in most LDCs, and the main source of this is traditional biomass, predominantly wood. In Sub-Saharan Africa, for example, 70-90% of total energy used is generated from traditional biomass, most of which is used for cooking (Larsen et al. 2008). More efficient stoves and easier access to alternative clean cooking fuels can reduce the time spent by women and young girls

in collecting traditional fuels, thereby increasing opportunities for education and income-generating activities. Using traditional fuels such as wood, charcoal and agricultural waste in inefficient cooking stoves is associated with health risks due to indoor air pollution. Cleaner fuels such as LPG and improved stoves can, together with improved ventilation, minimise the exposure to smoke and thereby reduce the risk of respiratory diseases, especially among women and children. Several concrete technologies exist which all have the potential to generate energy for cooking more efficiently. These include:

- improved wood and charcoal stoves
- more efficient wood coal
- biogas produced from livestock manure and household waste.

All these technologies have been thoroughly tested and are widely used in LDCs. A number of LDCs, especially in Africa, have implemented large-scale projects to improve access to clean and efficient cooking fuels and stoves. Which technology to apply in any particular setting depends on local conditions and the availability of resources. For instance, biogas from livestock manure is well suited for the farming models applied in Southeast Asia, where each rural household typically keeps livestock in pens close to the house. The typical small-scale farm in Africa may not have the same advantages in applying this biogas technology. In many African countries, affordable improved cooking stoves, which reduce charcoal consumption by 30-50%, have been developed since the 1980s and are now widely used, but mainly in urban areas. The results of cleaner wood-stove dissemination in rural areas are still quite poor.

Technologies that can improve cooking fuels and stoves have the potential to reduce current GHG emissions from inefficient cooking stoves, and/or to substitute fuels with higher emissions. The actual scope of emissions reductions from these technologies is dependent on the extent to which local fuelwood collection contributes to deforestation in the location in question (a connection that is often assumed, but still poorly understood in many areas). The major developmental advantage of improved cooking fuels and stove technologies lies in their potential to improve health, reduce the time needed for fuelwood collection and generate local environmental benefits. The low-tech nature and affordability of the more efficient cooking stoves make them a very suitable option for poor households.

Motive power

Access to motive power is critical to a range of productive and income-generating

activities at both the household level and in local small-scale enterprises which can provide employment opportunities in the community. Motive power is needed for pumping water, processing wood and welding, as well as for agricultural processing tools such as grinders, mills, de-huskers and oil presses. Low carbon motive power may be provided through:

- wind power
- diesel engines fuelled partly or fully by bio-fuels
- low carbon electricity

The affordability of small-scale wind-energy technologies are improving as the technology is maturing and starting to benefit from economies of scale as production and markets increase. Rising fuel prices will further strengthen the competitiveness of wind power and other renewable energy technologies.

Biofuels such as Jatropha oil can be used in diesel engines, thereby replacing fossil fuels. There are a number of social and environmental risks associated with the sharp increase in biofuel production. These are discussed further in the following section on energy for transport.

In general, the economic benefits of providing motive power to poor communities (for both local production and broader economic growth), together with its significant potentials in applying low carbon energy sources, makes this option very suitable for inclusion in a pro-poor low carbon development strategy. However, the relatively high initial investments needed for some technologies such as wind power makes it necessary to identify suitable financing mechanisms to initiate such investments at the local level. This is consistent with the initiatives recently put forward by the Danish government's Africa Commission, recommending support to renewable energy development and assistance to local energy entrepreneurs, including access to credit.

Energy for transport

In LDCs, transport accounts for some 20% of GHG emissions in the energy sector. Low carbon options with the potential for poverty alleviation include:

- more efficient public transport
- switching fuels from diesel to gas (natural and/or LPG)
- locally produced biofuels

More efficient public transport and fuel-switching schemes have been developed in a number of developing countries, the most well-known example being the Transmilenio in Bogotá, Colombia, which has brought great benefits to local people's mobility, local air pollution and GHG emissions reductions.

The use of biofuels for transport has been much debated in recent years. On the one hand it has been claimed that they contribute a solution to the fossil fuels crisis and provide a way to ensure a future low carbon transport sector. Others have emphasised the serious risks involved in using agricultural crops for biofuel production in terms of their adverse effects on the local environment and livelihoods. Biofuel production has also been linked to the rise in recent years in global food prices, the marginalisation of poor small-scale farmers and the increased pressures on forests and wetlands (Cotula et al. 2008).

Figure 2: Indicative assessment of practical options in energy

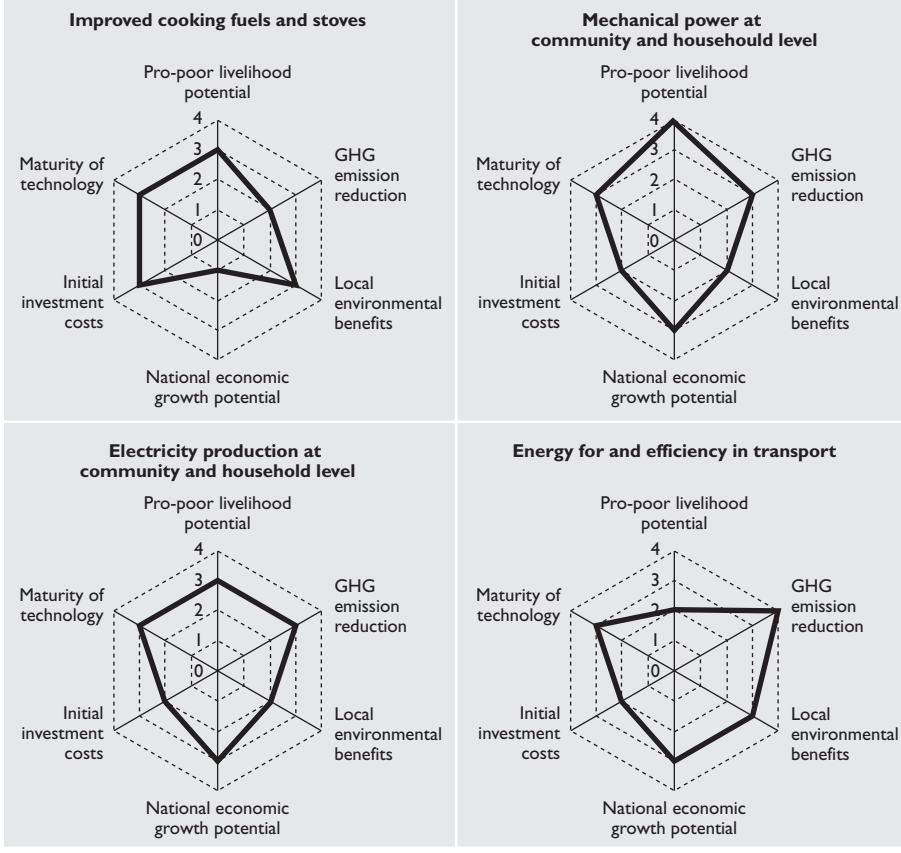


Figure 2 summarizes the pros and cons of selected low carbon options in relation to their potential for poverty alleviation and various other factors. A more detailed rationale for the assessment is provided in Annex E.

Policy issues in low carbon energy development

In many LDCs, the government subsidises electricity, petrol and diesel prices in order to support local economic activities. But the subsidised low prices of these forms of energy undermine the potential for renewable energy sources to penetrate the market (at a higher price) and therefore also limits investment in developing such low carbon alternatives. This highlights the importance of analysing low carbon development opportunities from the perspective of incentives and disincentives. Much can be achieved by adapting policy and legislation that currently creates disincentives for investing in low carbon development, such as subsidised prices for grid electricity, diesel and gasoline.

One of the dilemmas that governments will face is when to invest in low carbon energy technologies that are gradually improving in quality and becoming more affordable, but are still not competitive in price with conventional energy sources in the short term. In most LDCs, energy-sector development is at a very early stage. This creates some opportunities for embarking on a low carbon development path without having to think about phasing out an existing conventional energy infrastructure. Decision-makers must look at these issues using a long-term perspective and include the alternative costs of developing a conventional energy infrastructure, which will eventually have to be converted to low carbon within a foreseeable future. If decision-makers in LDCs choose to embark on a long-sighted low carbon development path right away, they must ensure that there is the necessary subsidy regime to encourage investments in low carbon options which are not yet economically competitive in the short term. Getting tariff and subsidy policies right is thus a very important step down the low carbon development path.

Another dilemma facing low carbon energy policy-makers is that some large-scale renewable energy options, such as large-scale hydropower, carries serious risks of negative social impacts and environmental degradation. The costs of compensating these negative impacts can easily outweigh the benefits of such investments. It is therefore crucial to develop institutional and legal frameworks and safeguards that can help ensure socially and environmentally responsible low carbon energy infrastructure development.

4. Options in Agriculture

4.1 Agriculture, climate change and livelihoods

The role of agriculture in local livelihoods

Approximately 70% of the world's poor live in rural areas. Whether as small-scale farmers and livestock keepers or as agricultural labourers, the majority of the rural poor depend on agriculture for their livelihoods. Furthermore, in many developing countries, rural areas and agricultural production serve as an important fall-back option for returning migrants who have come back either due to a lack of work opportunities or to old age. Thus, as stressed in both the World Development Report 2008 on Agriculture for Development (World Bank 2008b) and the International Assessment of Agricultural Knowledge, Science and Technology for Development (IAASTD 2009), there are strong reasons to find ways to support the agricultural sector to enhance its contribution to pro-poor development, and to climate change mitigation, as proposed by, for example, "the African Climate Solution" (COMESA 2009).

While farming and livestock-keeping are often highly adapted to local conditions, in many LDCs government policies have failed to provide effective frameworks and information in support of small-scale farming. Population increases in some areas and a lack of labour due to HIV/AIDS in others have further contributed to the decline or stagnation of small-scale agriculture. Rural smallholders across many LDCs thus face significant livelihood challenges, and this is further compounded by climate change, which in many parts of the developing world significantly changes the patterns of seasonal and annual variation and the frequency of extreme weather events, whether droughts or excessive rainfall.

The fourth assessment report (AR4) of the Intergovernmental Panel on Climate Change (IPCC) characterizes Africa as a continent that is highly vulnerable to climate change and variability, aggravated by multilevel stress and low adaptive capacity (AR4 2007; Chapter 9). AR4 maintains that, while African farmers have developed several adaptation options to cope with current climate variability, these may be insufficient to cope with future changes of climate. The report warns that "projected reductions in yield in some countries could be as much as 50% by 2020, and crop net revenues could fall by as much as 90% by 2100 with small-scale farmers being the most affected"(ibid.:435). The uncertainties over these projections, however, are high. There is limited empirical evidence indicating how serious these

future climate changes will be and how far they will affect the African agricultural sector in all its diversity. General estimates of mean air temperature increases exist, ranging up to 7°C for southern Africa and up to 9oC for northern Africa. Precipitation projections exist, of a similar nature. However, as the report stresses, the levels of uncertainties associated with such projections make it "difficult to provide any precise estimation" of the potential impacts of climate change in terms of agricultural production.[5]

Agriculture and climate change

Agricultural production is estimated to be directly responsible for 13% of global GHG emissions (Figure 1). Adding the GHG emissions associated with the production and transport of agricultural inputs, such as fertilizers and pesticides, agriculture is estimated to be responsible for an additional 15% of global GHG emissions (UNCTAD 2007), making it responsible for a total of 28% of global GHG emissions. Agriculture, however, also has the potential to store carbon in vegetation and soils and thus to offset CO_2 emissions.

Agriculture is currently known to contribute to GHG emissions in five major ways:

i. release of stored carbon from vegetation and soils; due to the loss of top soil caused by insufficient soil cover and the gradual depletion of organic matter in the soil, agriculture's ability to store carbon and thus offset CO_2 emissions is reduced every year
ii. emissions of nitrous oxide (N_2O) from nitrogen fertilizers and manure; agriculture is estimated to be responsible for 84% of global anthropogenic nitrous oxide emissions (Smith and Bertaglia 2007)
iii. emissions from fossil fuels (agricultural machinery and fertilizer and pesticide production and transport)
iv. emissions of GHG from pesticide application
v. emissions of methane (CH_4) released primarily through livestock (cattle) and paddy rice production; agriculture is estimated to be responsible for 52% of global anthropogenic methane emissions (Smith and Bertaglia 2007)

As more knowledge becomes available, agriculture's actual contribution to GHG emissions may turn out to be significantly higher. Until now, only limited attention

5 Aggregate estimates of agricultural losses in the order of two to seven percent of current GDP are being presented, and major changes in cropping patterns are foreseen, such as wheat production disappearing from Africa by 2080 (AR4, 2007, Chapter 9; 443-448).

has been paid to the direct effects of pesticides as greenhouse gasses. Recent research suggests, however, that some pesticides may be significantly stronger and longer lasting as greenhouse gasses than previously assumed. Similarly, recent evidence indicates that the production of bio-energy could end up becoming part of the climate problem as much as or rather than a solution.[6]

In LDCs, direct emissions from agriculture are generally estimated to account for 17% of total LDC emissions. No data has been found on the relative distribution of emissions between large-scale and smallholder farming.

4.2 Practical mitigation options in agriculture

Many agricultural practices can potentially mitigate greenhouse gas (GHG) emissions, the most prominent of which is the reduction of soil carbon dioxide emissions through improved soil management on crop and grazing lands and the restoration of degraded lands.[7] Particularly in Africa, but also in Asia and Latin America, agricultural production carried out by poor farmers involves limited or no use of commercial agricultural inputs such as synthetic fertilizers[8] and pesticides. Instead, it relies on a combination of crop and fallow rotation, sometimes with leguminous crops, mulching, and to some extent the use of animal manure. Thus, due to its low reliance on energy-intensive inputs, poor people's farming is in a sense already "low carbon". One social or developmental problem is, however, that in most cases area and labour productivities are too low to provide the majority of these producers with a pathway out of poverty. Thus, in searching for pro-poor low carbon development options within agriculture, the challenge is to identify agronomic and animal husbandry practices which enable increased productivity – also in the context of current and future climate variability – *without* increasing and where possible reducing GHG emissions (Izac et al. 2009). The following section assesses the main options for addressing agriculture's major contributions to global emissions in this respect.

6 The production of biofuel crops may release so much nitrous oxide (N_2O) – a GHG affecting the climate 298 times more than CO_2 does – that it would negate any CO_2 emissions reductions offered by replacing fossil fuels with biofuels (The Economist, 11 April , 2009: 73, based on research conducted by the International Council for Science and the Max Planck Institute.

7 Reduction of soil carbon dioxide emissions is estimated to account for almost 90 per cent of the mitigation potential directly associated with agricultural production (Smith, 2009).

8 On average, in 2002-2003 nine kilos of fertilizer nutrients were applied per hectare of arable land in sub-Saharan Africa, while in Latin America, an average amount of 73 kilos were applied. For South Asia and Southeast Asia, an average of 100 kilos and 135 kilos, respectively, of fertilizer nutrients were applied per hectare of arable land (FAO 2004, here quoted from Crawford et al. 2006: 27).

Enhancing soil carbon storage

Improved soil management can contribute to enhancing both agricultural production and soil carbon storage capacity. Due to in some places very intensive and in other places very extensive agricultural forms of production, top soils are being lost from land areas worldwide 10 to 40 times faster than the rate of soil renewal (Gomiero et al. 2008). Most of the soil organic matter – and thereby the carbon storage – is found in the top soil. Therefore, the loss of top soil significantly reduces the carbon storage ability of the soil and thus its ability to offset CO_2 emissions into the atmosphere. Moreover, with lower contents of soil organic matter, the water-holding capacity of the soil decreases, reducing the ability of the soil to provide at least some degree of yield stability in the face of increased climate variability, which in many parts of the developing world is the likely scenario both now and in the coming decades. Improving soil management, and in particular increasing soil organic matter content, can thus contribute to enhanced production among LDC farmers, while at the same time increasing soil carbon storage. It thus constitutes a promising option for mitigation, as well as for adaptation to climate change, particularly as it relates to water stress.

Various options exist for improving soil management and thus enhancing the soil carbon storage capacity. These include (i) minimum tillage; (ii) returning crop residues to the soil; (iii) crop rotation, including use of green manure and cover crops; (iv) mulching; and (v) the use of animal manure and compost. As an illustration of the potential importance of such measures, researchers estimate that adopting organic agricultural practices in the maize/soybean growing region in the United States would increase soil carbon sequestration by 0.13 to 0.30 10^{14} g per year. This is equal to 1-2% of the estimated carbon released into the atmosphere from fossil fuel combustion in the United States (Gomiero et al. 2008: 248). These practices can therefore be further developed and supported, not only as good agricultural husbandry practices, but as specific climate mitigation measures.

Reducing emissions from pesticide application

Recent research suggests that several pesticides in themselves constitute GHGs which in some cases are much stronger than previously assumed. As an example, recent research has established that the insecticide based on *sulfuryl fluoride*, which has been used in the 1960s in the United States and is permitted in the European Union, is 4800 times stronger as a GHG than CO_2 and that it lasts longer in the atmosphere than previously assumed (Ingeniøren 2009). The fact that knowledge of the effects of pesticides as GHGs is still incomplete warrants an even more cau-

tious approach towards promoting their use further. Although pesticides are used to some extent as part of the production of staple foods, their use is particularly associated with the more intensive production of vegetables, fruits and flowers, which are often grown in greenhouses. Although such farming may generate employment, there are strong reasons to be cautious in supporting such enterprises in LDCs with only limited environmental regulation, both from a climate change perspective and from a broader environmental and work-related health perspective.

Reducing emissions from large-scale livestock production

Livestock, and cattle in particular, also contribute significantly to global warming through CH_4 emissions (methane) (Steinfeld et al. 2006). However, the extent to which different livestock production systems contribute to emissions is as yet poorly documented. A holistic approach may be needed so as to also factor in the wider land-use systems of which livestock form part. For instance, studies suggest that some extensive pastoral systems act as net carbon sinks, as cattle emissions are off-set by the carbon storage in the soils and the vegetation of the extensive grasslands on which they are traditionally based (Neely and Bunning 2008). In other areas, pastoralist production may be under pressure or for other reasons may lead to a habitat degradation which leads to increasing emissions (Mills et al. 2005). Some authors therefore argue that the restoration of pastoralist grazing areas alongside the devolution of rights could in some cases lead to significant emissions reductions.[9] This focus can be combined with efforts to promote the integration of crop and animal production, which permits the direct use of animal manure in soil management and serves to increase both soil fertility and soil carbon storage capacity.

Other practical options

Direct emissions of *fossil fuels* from agriculture stem primarily from the use of agricultural machinery, including pumps for irrigation, while indirect emissions from agriculture relate primarily to the use of synthetic fertilizers and pesticides. While on a global scale there is significant scope for reducing both direct and indirect emissions from fossil fuels, this potential is limited in the case of LDCs due to their low degrees of mechanisation and of fertilizer and pesticide use. Likewise, the potential for reducing the emissions of *nitrous oxide from fertilizers* and *manure* are limited, particularly among the poorer segments of the farming population.

9 Sustainably managed grasslands have been calculated by the FAO to sequester 260 tC02 per hectare, while also providing important livelihood and adaptation benefits (quoted in Neely and Bunning 2008).

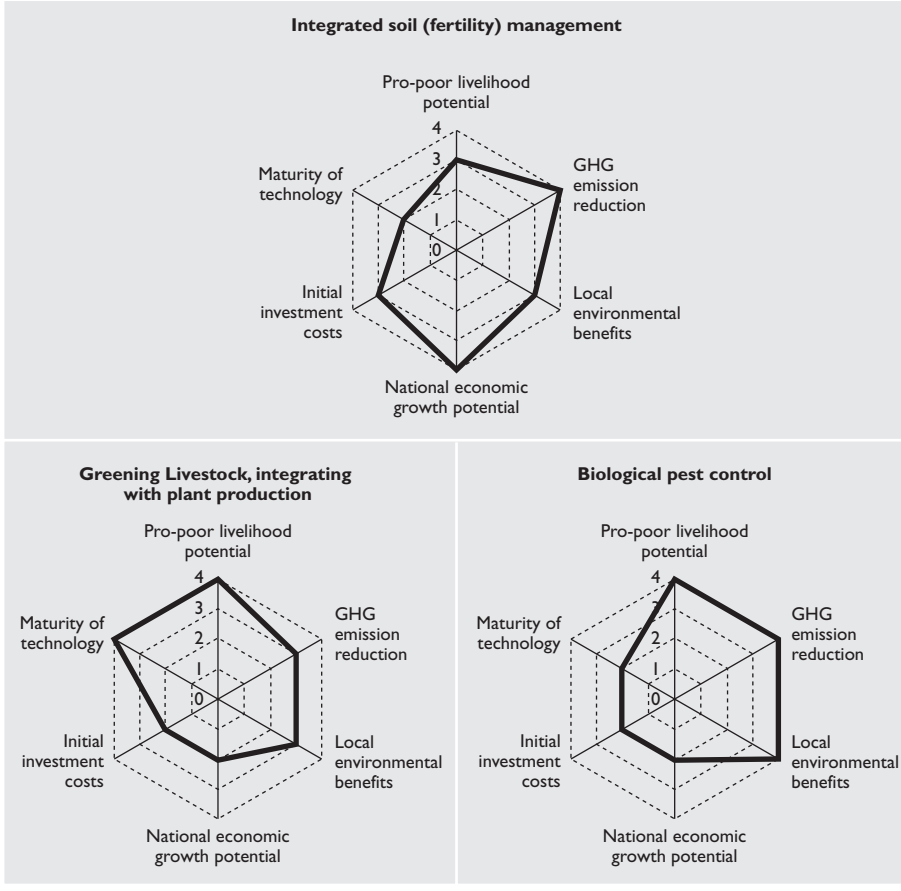
Within the above five options (carbon storage, reduced pesticide use, integration of crop and animal production, reduced use of fossil fuels and synthetic fertilizers, particularly N fertilizers), the main scope for LDCs thus appears to be in improved soil management, in reducing emissions from pesticides, and possibly in addressing livestock production (although more knowledge is needed on this latter point, especially as mixed crop-livestock farming present itself as an under-explored option). Figure 3 provides an indicative assessment of these three approaches in terms of poverty alleviation and five other factors. The rationale behind these assessments is provided in Annex F.

Policy issues in low carbon agriculture

There are strong reasons to focus on agriculture in both adaptation and mitigation. The sector is responsible for a significant proportion of GHG emissions (including in LDCs), and significant potential exists for enhancing carbon sequestration capacity in agricultural production. A lot is already known about techniques (soil organic matter and fertility management) that enhance soil carbon storage capacity.

Results are emerging from comparisons of the energy efficiency of conventional versus organic agricultural production in different parts of the world (although as yet less so from tropical conditions). These suggest that organic farming is significantly more energy-efficient than conventional (i.e. input/energy-intensive) farming on a *per-hectare basis*. When viewed on a *per-output basis*, in many cases conventional agriculture in the North tends to be as much or sometimes even more energy efficient than (industrialized) organic farming (Gomiero et al. 2008: 244-45). However, there are indications that this latter picture may change when viewed over a longer time period of, for example, ten to twenty years, as well as with variable climatic conditions (ibid.). Also, it is not known to what extent findings based on temperate regions are indicative of how conventional and organic farming compare in tropical agriculture. While energy efficiency reflects an important component of GHG emissions from agriculture in areas characterized by mechanized agriculture, it does not reflect the full spectrum of the GHG emissions. For example, it does not reflect GHG emissions that result directly from pesticides, nor does it reflect the methane emissions associated with livestock production. Hence, while important, energy efficiency does not constitute a sufficient indicator for comparing GHG emissions associated with different types of agricultural production. Thus there is a need to develop further the methodological basis upon which such assessments are made.

Figure 3: Indicative assessment of three practical options for supporting agriculture in LDCs



Despite the significant technical potential for mitigation in agriculture, there is little evidence of policy measures to promote such developments so far. Barriers exist that are unlikely to be overcome without a revision of incentive structures. In his contribution to "An Agenda for Negotiation in Copenhagen", IFPRI Fellow G.C. Nelson calls for new and cost-effective payment mechanisms to encourage agricultural mitigation (IFPRI 2009). For instance, if we consider organic certification as a proxy for low carbon agriculture, a major problem is that the cost of the organic certification is currently paid by the consumers of organic products, and often also by organic producers who are not (fully) compensated for their certification costs. In addition, numerous farmers, primarily in developing countries, are *de facto* organic

farmers without being certified nor remunerated as such. Society obtains ecological services such as carbon storage that are "free of charge", leading to a free-rider problem.

So far, the only operational institutional mechanism available for governments, including national bureaus of statistics, and consumers which ensures that such low carbon emission techniques are adopted in agricultural production is the internationally recognized system for organic certification.[10] Thus, to stimulate the further development and adoption of low carbon agriculture, there is a need to make certification more accessible to producers both in economic terms and in terms of the types of certification.

Such efforts to support environmental certification should go hand in hand with, on the one hand, support to effective regulation of pesticide use, both in terms of types and quantities, and of the use of chemical fertilization; and on the other hand, support to the further development of climate-friendly soil management and crop and livestock husbandry practices through agricultural research and extension. It should further be noted that, while positive incentive mechanisms should be promoted wherever possible, there may be situations in which restrictions and regulations constitute the most cost-effective option in promoting low carbon agriculture.

10 Certified organic agriculture (COA), has been internationally harmonized by the Codex Alimentarius, EU and the international federation of organic agriculture movements (IFOAM), and is therefore operationally and verifiably defined and regulated by a global certification regime, which is widely recognized by consumers and governments across the world.

5. Options in Forestry[11]

5.1 Forests, climate change and livelihoods

The role of forests in local livelihoods

Worldwide, some 240 million live in the forest areas of developing countries, of which 60 million are defined as Indigenous Peoples. Both wet and dry forests are vital assets for a significant proportion of the rural poor, providing food (wild vegetables, fruits and meat), energy (wood fuels), health services (natural medicines) and shelter (construction materials). To this can be added the crucial eco-system functions provided through forests, including the natural filtration and storage of water resources, of importance both to rural and urban communities.

Forest users comprise a much wider spectrum of stakeholders than what is sometimes perceived simply as "people living in the forest". This may include groups not normally associated with forests, such as pastoralists exploiting grazing and water resources in dry forests. Likewise, the significance of the forest sector as a labour opportunity is not always recognized. Some 17 million people work in the formal forestry sector of developing countries, with a further 30 million employed in the informal sector (the latter ranging from, for example, small-scale commercial charcoal production to pit-sawing and locally or community-owned timber production). Estimates suggest that 13-35 % of all small and medium enterprises (SMEs) in rural areas are forest-related (Robledo et al. 2008). Forest SMEs also play an important role in national economic terms, and tend to dominate domestic timber markets in developing countries, whereas large-scale enterprises focus on exports. In poverty terms, SMEs tend to show good results in spreading funds locally, although the initial investment costs may keep out the poorest (Mayers 2007).

Forests resources are furthermore among the first resources that rural households turn to as part of their coping and adaptation strategies. It is precisely because forests serve as significant elements in the coping strategies of communities that the forest sector has good scope for supporting a pro-poor forest-management process that can help build adaptation resilience, while at the same time addressing mitigation issues.

11 The issues discussed in this section are elaborated further in the separate DIIS Report "*Reducing Emissions from Deforestation and Degradation: An Overview of Risks and Opportunities for the Poor*", Danish Institute for International Studies, 2009.

Forests and climate change

Most major deforestation assessments, including those of the IPCC, are based on the FAO 2005 World Forest Resources Assessment, which assessed forest change from 1990-2005. These show a slight drop in the rate of deforestation for the period 2000-2005, but nevertheless indicated a global annual loss of 7.3 million ha during this period.

Table 1: Forest area, forest loss and current carbon stocks

Region	Forest area (mill. ha)		Annual change (mill. ha/yr)		Carbon stock in living biomass ($MtCO_2$)		Growing stock in 2005
	2005	1990-2000	2000-2005	1990	2000	2005	million m^3
Africa	635,412	-4.4	-4.0	241,267	228,067	222,933	64,957
Asia	571,577	-0.8	1.0	150,700	130,533	119,533	47,111
Europe[a)]	1001,394	0.9	0.7	154,000	158,033	160,967	107,264
North and Central America	705,849	-0.3	-0.3	150,333	153,633	155,467	78,582
Oceania	206,254	-0.4	-0.4	42,533	41,800	41,800	7,361
South America	831,540	-3.8	-4.3	358,233	345,400	335,500	128,944
World	**3,952,026**	**-8.9**	**-7.3**	**1,097,067**	**1,057,467**	**1,036,200**	**434,219**

a) Including all of the Russian Federation
Source: IPCC Third Assessment Report 2007: 545 (using FAO 2005 data)

Table 2: Global land-use change emissions

Deforestation	18,3
Afforestation	-1,5
Reforestation	- 0,5
Harvest/Management	2,5
Other forms of lands use change	-0,6
Net total land-use change	**18,2**

Source: WRI Climate Analysis Indicators Tool
http://cait.wri.org/figures.php [accessed March 12, 2009]

The causes of ongoing global deforestation and degradation are commonly attributed to a number of factors, including in particular agricultural expansion, wood extraction and infrastructure extension. These are in turn related to broader economic and political processes at the national and international levels, including consumption patterns in the North. Emissions of CO_2 from deforestation are primarily caused by the burning and clearing of tropical forests and their vegetation, as well as the burning of wood and the decomposition of trees harvested for lumber. Forests also act as net carbon sinks for emissions from other sectors, one recent study suggesting that 18% of emissions from fossil fuel are recaptured by primary forests (Lewis et al. 2009). Globally, land-use change and forestry is estimated to account for 18.2 % of GHG emissions,[12] or 1.6 billion tonnes of carbon emissions annually – more than the global emissions from the transport sector, and almost equivalent to the total emissions from US fossil-fuel use. Deforestation and degradation has contributed some 90% of total global emissions from global land-use change since 1950 (Robledo et al 2008).

After centuries of deforestation and degradation in North America and Europe, these regions have now become net sinks for emissions. According to the IPCC (2007), 65% of the mitigation potential in the global forest sector is located in the tropics. While total emissions from LDCs for all sectors constitute only 5% of global GHG emissions, LDCs are responsible for 20% of the global emissions that stem from land-use change and forestry.[13] Land-use change and forestry are thus the only truly significant sources of emissions from LDCs in global terms, as well as within LDCs, where 74.4% of emissions derive from this source (see Figure 1). Annex D provides an overview of emissions from land-use change in Danida partner countries.

5.2 Practical mitigation options under REDD

Current debates over forestry and climate change mitigation center on the development of a global scheme for Reduced Emissions from Deforestation and Degradation (REDD) under a post-2012 UNFCCC regime after the current Kyoto Protocol expires in 2012. Through the development of international mechanisms and possible associated carbon credit schemes, it is envisaged that developing countries

12 GHG emissions from deforestation and degradation are mainly of carbon dioxide and, to a much lesser extent, carbon monoxide and methane.

13 LDCs are estimated to emit an equivalent of 1,543.8 Mt CO_2 through land-use change and forestry, while global emissions from land-use change and forestry are estimated to amount to 7,618.6 MtCO_2.

may be financially compensated for reducing emissions through national measures to reduce deforestation and degradation. However, the exact nature of such a mechanism is still under debate, and a range of different proposals are currently on the table. The nature of REDD is thus one of the issues up for negotiation at the upcoming COP15 in Copenhagen. Because of its centrality in current forest and climate debates, and because of its potentially significant impacts on local forest livelihoods, this section is focussed on the pro-poor options and risks specifically associated with a REDD framework. However, REDD is understood here in broad terms as a suite of possible options related to reducing emissions while at the same time fostering development.

Overall REDD benefits and risks for the poor

REDD is a double-edged sword: while it has significant potential for supporting poverty alleviation, it also carries with it the distinct possibility of worsening poverty for rural communities. Under a "best-case scenario", positive REDD–poverty linkages take place through three main factors, namely:

1. The positive impacts of potential benefit-sharing arrangements under REDD, in which the financial benefits from carbon credits are devolved to local stakeholders as Payment for Environmental Services (PES), and which can thereby be used for communal and/or individual investment.
2. The positive effects of improved and more efficient forest management policies and practices, which will be provided by governments and/or projects in return for carbon funding. If effective, these can provide important contributions to local livelihoods through improved forest products, income opportunities, ecosystem services etc. In supporting this, REDD can also help provide significant options for climate change adaptation.
3. The positive effects on local rights and governance mechanisms that may derive from the process of establishing and negotiating institutional mechanisms and rights regimes related to REDD. This may include the increased formal recognition of local forest rights and more accountable and inclusive forest governance mechanisms.

By contrast, a "worst-case" scenario might produce a series of mutually re-enforcing negative effects, which can be summarized as:

1. Alienation and loss of forest resource rights for forest-dependent communities, as a result of public and private intrusions on financially valuable forest areas.

This may happen either directly, through actual take-overs of forest areas, or indirectly through, for example, hardline state crack-down on existing forest use by communities.

2. Increasing land and food costs, as current agricultural expansion is halted, forest areas are value-added, and/or REDD-supported efforts such as afforestation and reforestation drives up land prices. This may be further affected by parallel developments of biofuel production schemes that further drive up land values and/or take over smallholder land, with associated food price increases.
3. Reduced subsistence and adaptation options. Reduced access to forest products as a result of the above processes will affect local livelihoods in terms of shelter, food and health. Likewise, income opportunities may decline as a result of aborted or scaled-down forest sector production. Adaptation and coping strategies based on forest resource-use may also decline. If this happens in tandem with declining agricultural performance as a result of climate change, local livelihoods may become subject to a "double squeeze" whereby both agricultural production *and* options for supplementing livelihoods with forest resources are reduced at the same time.

These potentially negative effects are substantial and in direct contrast to collective international development goals such as the MDGs. For the poorest, they would be catastrophic. The option of simply dismissing any form of REDD is therefore tempting. Nevertheless, REDD also provides potential new opportunities for a more pro-poor and inclusive forest governance agenda that may not otherwise occur (Rights & Resources 2008). Indeed, the risks of *not* engaging in REDD seem high, given the possibly complete disregard for poverty and rights issues that might develop from such an approach. The extent to which REDD outcomes end up in the "best" or "worst" case scenario (or somewhere in between) depends on a number of issues, not all of which lie are connected with REDD itself, such as the effects of world economic fluctuations, the extent to which ongoing climate change affects existing forests, or the ways in which local actors respond to REDD in the broader context of other local and national development processes. Nevertheless, important steps can be taken in how REDD is developed and designed, and the principles upon which this is based. This includes:

i. the design options for a possible global forest carbon funding mechanism
ii. the practical mitigation options that may be accommodated within REDD
iii. the national policy and governance efforts required

In all of these areas, governance plays a key role, since the different stakeholders in REDD do not necessarily have similar interests and aims. Apart from ensuring efficient financial mechanisms, monitoring systems etc., a pro-poor development of REDD is therefore also very much about ensuring fair representation and ownership among LDC governments and stakeholders.

Practical REDD mitigation options

The following briefly summarizes selected practical mitigation options and related national policies.[14] Angelsen and Admajda (2008) identify four main REDD-related mitigation options, as follows:

Changes in:	Reduced Negative Change	Enhanced Positive Change
Forest area (hectare)	Avoided deforestation	Afforestation and Reforestation (A/R)
Carbon density (carbon per hectare)	Avoided degradation	Forest restoration and rehabilitation (carbon stock enhancement)

Source: Angelsen and Admajda 2008: 15. See also IPCC 2007b and Robledo et al. 2008.

In practical terms, actions under Avoided Deforestation and Avoided Degradation imply payment for *not* undertaking deforestation (e.g. clear-cutting or other forms of land clearing) or degradation (e.g. unsustainable selective logging or other forms of degrading resource extraction). Payments would then cover or exceed the opportunity costs (e.g. the lost revenue from not logging). Actions under A/R and Forest Restoration would involve payments for making an active effort actually to *improve* the extent or quality of forest land. Payments would then contribute to, cover or extend the cost of such efforts.

Figure 4 provides an indicative assessment of the strengths and weaknesses of the four main REDD categories discussed here. The detailed argumentation for this assessment is provided in Annex G. It should be noted that this is a preliminary and overall indicative assessment. The actual outcome will depend on *how* the various options are applied in practice, and how different LDCs are equipped to take them on. This in turn will depend greatly on the eventual design of REDD at the international and national levels.

14 For a more in-depth discussion of these and international REDD design issues in relation to poverty alleviation, see, e.g., Peskett et al. (2008), Funder (2009).

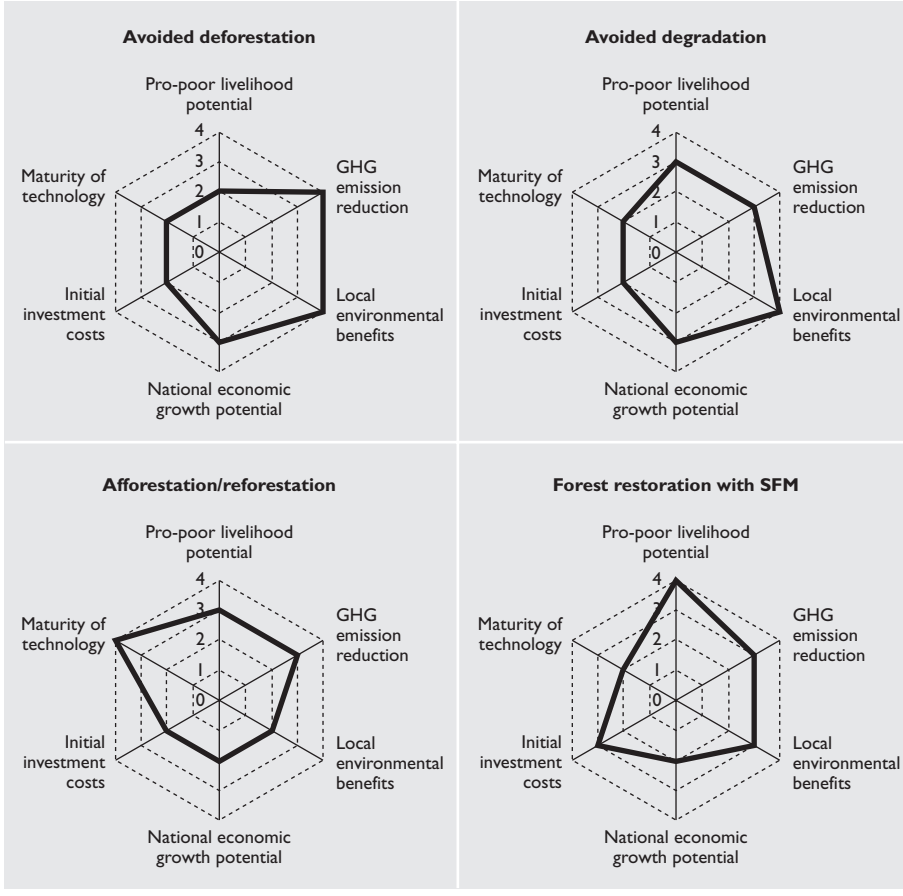
Towards a "REDD Plus" approach

So far, the REDD debate has tended to focus on the scope for Avoided Deforestation and, to a lesser extent, Avoided Degradation (i.e. the former two approaches). Until recently, far less attention was given to the so-called "REDD plus" solution, that is, also rewarding the positive enhancement of carbon density and forest areas through Afforestation/Reforestation (A/F) and Forest Restoration and Rehabilitation. There is, however, an emerging interest among some developing countries to include payments for these latter options under REDD (especially in countries with relatively extensive community forestry schemes, such as Nepal and Tanzania). The wording of the Bali Action Plan and the 2008 Accra talks provided an initial opening for the incorporation of forest restoration and sustainable management activities under REDD, although this remains vague and has been met by opposition from countries such as Brazil which have expressed concerns over the transaction costs of expanding the scope of REDD (Schmidt 2008).

A REDD approach that is focused only on Avoided Deforestation may provide certain benefits to the poor, but also has the biggest potential for a polarization between climate and poverty goals, and thereby carries the greatest risks for the poorest: by reducing or refraining from logging and other land clearing, large emission reductions can be made under Avoided Deforestation. However, it is also here that the risks of overriding local rights and resource use are greatest, and it is here that many of the poorest will not be entitled to economic benefits, as they are not involved in logging and land clearing in the first place.

Figure 4: Indicative assessment for LDCs of the potential strengths and weaknesses of the four practical forestry "options" as currently debated in REDD (see Annex G for detailed assessment)

1=Lowest potential, 4=Highest potential (for investment costs, highest cost =1, lowest cost = 4)



SFM= Sustainable forest management

Avoided Degradation contains many of the same risks, although it can more easily be linked to pro-poor activities such as forest restoration and Community Based Forestry.[15]

15 Skutsch (2008a, 2008b) has suggested that Avoided Degradation should be re-conceptualized in REDD terms and measured and rewarded as part and parcel of activities for Forest Restoration and A/R.

The "REDD Plus" option of bringing in Forest Restoration and A/R efforts would potentially expand the scope for REDD poverty-reduction effects. If the focus is only on Avoided Deforestation and Degradation, there is a major risk that funds will go mainly to large-scale commercial operators and governments. Within A/R and in particular Forest Restoration activities, the scope for rewarding communities through their contribution to enhanced forest carbon density or area currently seems more likely. Such approaches will also provide greater potential for linkage to Sustainable Forest Management, and thus to ongoing community *use* of forests as an integral part of REDD.

This does not mean that A/R and forest restoration contain no risks for the poorest: the negative environmental and social impacts of some A/R schemes in, for example, India bear witness to that. Likewise, the conversion of primary forests to, for instance, oil-palm plantations in the name of emissions reductions is highly problematic (Danielsen et al. 2009). Adopting a REDD Plus approach does not in itself mean that the issue of poverty alleviation would be "sorted". Likewise, taking a "no-harm" approach to the poor in REDD seems problematic: apart from the risk that such formal principles would be ignored in practice, no-harm approaches may also significantly disfavour the stakeholders concerned in negotiation, decision-making and conflict resolution in forest governance, since they would not be considered actual "stakeholders" in REDD. This would also deprive them of the potential benefits they might actually obtain under a pro-poor approach to REDD.

There is a need, therefore, to employ a REDD Plus approach which also recognizes and rewards the positive enhancement of carbon stocks, but with clear and uncompromised links to local rights and poverty alleviation. One obvious possibility is to link forest restoration to Participatory Forest Management (PFM).[16] In a review of the carbon financing potential of 13 CBF projects in East Africa and South/Southeast Asia, Murdiyarso and Skutsch (2006) concluded that such projects can be an effective way of reducing degradation and increasing sequestration. The study suggests that, while the emissions mitigation potential of CBF might not compare with that for larger scale Avoided Deforestation efforts, CBF can produce not insignificant improvements in sequestration. CBFs also include a number of other added benefits: for instance, because they are locally anchored, they often provide a better basis for addressing local land-use challenges and needs. Examples may include

16 It is estimated that 14% of the world's forests are now managed under some form of PFM, usually either as Joint Forest Management (partnerships between governments and local stakeholders) or Community Based Forestry (CBF), in which case communities assume management authority and use rights.

regulatory practices such as land-use planning, community-based monitoring and taxes on local commercial forest use (which are then used for community development purposes). CBFs can thereby often provide more effective regulation of forest use than states that may be under-staffed and lack the necessary "reach".

Policy issues in pro-poor REDD development

If LDCs are to benefit successfully from REDD, it will be necessary to address the actual drivers of deforestation: simply establishing an efficient financial global mechanism is not enough in itself. Generally speaking, four types of policy work will be required:

- *Providing frameworks for REDD to function as nationally legal mechanisms*, including the establishment of the necessary mechanisms and capacities for governments to market, monitor and account for forest carbon credits, but also (and controversially) possible revisions of constitutional and legal frameworks on national and local sovereignty and the ownership of national resources, in order to meet the commitments to REDD schemes.
- *Revision/development of forest-sector policies and legal frameworks.* This will be a key element in actually providing Avoided Deforestation and Degradation and supporting Forest Restoration, A/R and Sustainable Forest Management. In some countries, a major re-orientation of national policies and frameworks within forestry will be required. In others, relatively progressive policies may already be in place, but they are inefficient and will require greater emphasis, funding and capacity development at the national and local levels.
- *Addressing cross-sectoral drivers.* Policy revisions within the forestry sector will be ineffective if they do not address the underlying drivers behind deforestation and degradation. Regardless of how large the payments through REDD mechanisms may be, they will not in themselves address drivers from outside the forestry sector, such as agricultural expansion, infrastructure development and energy constraints. Strategic policy development and associated capacity-building on these issues is therefore an important but also challenging task.

The above policies and sector reforms may potentially have a number of positive spin-off benefits in terms of both national development and poverty alleviation. However, they also involve a number of risks for the poor that need to be addressed and mitigated already in the initial design and development of national REDD policies. Linking to Poverty Reduction Strategies and other poverty alleviation efforts

is one aspect of this, but the actual integration of pro-poor interests into specific REDD-related policies will also be necessary. This amounts to more than a few minor adjustments, and will include:

- *Ensuring the rights of forest-dependent communities to continued or improved access to forest resources.* This includes building clear definitions of local tenure or use rights into national legislation on forest resources generally and REDD specifically. Apart from actual forest-use rights, a key issue to clarify is the ownership of the actual carbon rights themselves, including whether this is a workable concept in the first place, and if so, how such rights can be established in a pro-poor fashion.
- *Developing transparent and pro-poor payment schemes.* Experience from local benefit-schemes suggests that even where policies and legal frameworks are in place to provide benefits at local levels, a number of risks remain. Ensuring that funds actually reach local beneficiaries is one major issue; ensuring that such benefits also benefit the poorest at local levels is another.
- *Enhancing inclusive forest governance.* Only limited attention has been given so far to the governance aspects of REDD at the national and sub-national levels, and how these may affect and be integrated into existing institutional frameworks in this respect. In general, it will be important to ensure that existing local institutions for forest governance are not sidelined, especially if they serve as de facto platforms for the articulation of community interests. Specific support to better representation of the poor in REDD governance institutions may be needed.

The development and adaptation of these policies poses distinctive challenges in ensuring pro-poor REDD and should not be under-estimated. Yet the good news is that many of the required modalities and approaches are already known and are being implemented in a number of countries, including under PFM, but also more broadly in terms of cross-sectoral coordination etc. While their success has been limited so far, REDD offers an opportunity to boost such approaches and ensure their actual implementation. This will, however, require the pro-poor agenda to be brought more centrally into the current REDD debate than is presently the case. If this does not happen, there is a real risk of REDD becoming a liability rather than a benefit to the poor.

6. Implications for development cooperation

This section points out key overall strategic issues and recommendations for development cooperation, followed by more specific recommendations for development assistance within energy, agriculture and forestry in particular.

6.1 Overall strategic recommendations

Ensure full LDC ownership and incentives in pro-poor low carbon development

The notion of low carbon development is gaining an increasing foothold among policy-makers in developing countries.[17] Nevertheless, the issue remains controversial in a context in which support to pro-poor low carbon development may easily be perceived as imposing constraints on national economic development. Moreover, sector policies and agencies within each country are far from always moving in the same direction. Hence, while environmental policy-makers may be promoting low carbon approaches, sector policies and decision-makers in, for example, energy, agriculture and forestry may continue to support more conventional approaches.

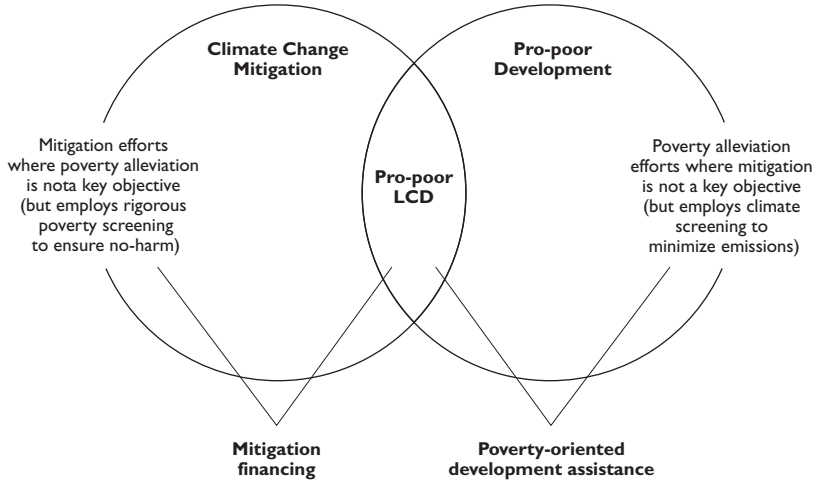
Development cooperation on these issues must therefore ensure that full national and local ownership and representation are de facto at the forefront of any intervention. This may seem self-evident, but examples of current support to mitigation show that this may easily be overlooked.[18] In this respect, there is a need to move beyond the current emphasis on global calculations of costs and benefits towards providing nationally and locally specific documentation of short- and especially long-term economic benefits, as well as transaction and opportunity costs. In so doing, it is paramount to keep in mind that a low carbon development process in LDCs does not necessarily imply a reduction of current emission levels. This may be so where LDCs carry a measure of responsibility for global emissions (as in deforestation and

17 For instance, the Nairobi Declaration adopted at the May 2009 African Ministerial Conference on the Environment states that "effective implementation of mitigation measures offers opportunities for Africa to increase its economic competitiveness along a sustainable path of low-carbon development" (AMCEN Nairobi Declaration, p. 2, May 2009; see: http://www.unep.org/roa/Amcen/Amcen_Events/3rd_ss/

18 For example, in the case of the Clean Technology Fund, critics have pointed out that final decision-making power over fund allocations remain exclusively with the funders. Likewise, civil society organisations have complained over a lack of representation for Indigenous Peoples in the Forest Carbon Partnership Facility. In both cases, efforts to accommodate the criticism are being made, although the outcomes in terms of de facto decision-making power remain to be seen.

land-use change). In other sectors, such as energy, a certain increase is inevitable and morally fair, and "low carbon" then becomes a question of minimizing the necessary emissions.

Figure 5: Relationship between mitigation financing, development assistance and pro-poor low carbon development



Ensure that poverty concerns "outside" climate change are not undermined

This report has pointed to areas where the dual objectives of pro-poor development and climate change mitigation may overlap. It is, however, crucial to avoid pro-poor climate change mitigation becoming the only target for poverty-oriented development assistance, since this would risk diverting funds away from pro-poor interventions in the wide range of other "conventional" fields of pro-poor development cooperation. Development assistance that is in principle targeted at poverty alleviation (such as that provided by the Danish Government and several other donors) should therefore remain so. Likewise, climate financing (whether market-based or provided by donors) cannot and should not always include specific measures to address poverty alleviation, although it should always follow a no-harm principle in this respect, and should employ rigorous measures to ensure this.

Figure 5 illustrates the relationship between mitigation financing, development assistance and pro-poor low carbon development. It shows how pro-poor low carbon development addresses the dual objectives of climate change mitigation and pro-

poor development (such as the options discussed in this report), but also emphasizes that there is a continued need for pro-poor development assistance that is not directly related to climate change (e.g. basic social service delivery, development of good governance etc.). Likewise, it is neither realistic nor necessary that all mitigation financing should include poverty alleviation objectives (although it should always follow a no-harm principle). The rest of this section is focused on options for donor cooperation related to pro-poor low carbon development specifically.

Support options that will have an impact regardless of international climate financing

LDCs do not currently feature prominently in funding flows for low carbon development, and experiences with the CDM suggest that there is a risk that LDCs may not benefit substantially from global mitigation and carbon financing mechanisms. Likewise, even if LDCs do benefit from such schemes, such benefits will not necessarily reach the poorest. On the one hand, this indicates a need to pay greater attention to pro-poor low carbon development in LDCs, but on the other hand it also highlights the risk of making poverty-oriented development funding too dependent on international climate mechanisms and climate-financing in these countries. It is therefore recommended that development assistance to pro-poor low carbon development be focused on options that will be beneficial for poverty alleviation, even if global carbon financing fails to reach the poorest. For example, supporting pro-poor fuel substitution or local rights in forest management could create strong synergies with financing aimed specifically at mitigation, but it will also deliver important results on its own.

Exploit options for synergies between adaptation and mitigation

The recent tendency towards a certain polarization between mitigation and adaptation efforts has meant that little attention has been given to the options for addressing both at the same time. One example of such opportunities is the role of forests as an important coping and adaptation strategy for the poor, as well as an important mitigation factor. Likewise, the use of Conservation Agriculture and related approaches in agriculture address both adaptation and mitigation objectives, just as fuel-efficient energy technologies in rural communities can help households enhance and/or diversify incomes while at the same time avoiding emissions from less climate-friendly fuels and technologies. Some donors have recently developed strategies that employ such a more holistic approach to adaptation and mitigation, including the World Bank's Strategic Framework on Climate Change and Development (World Bank 2008a) and the UNDP's climate change strategy (UNDP 2008).

Strengthen decentralized levels

A number of the options discussed in this report require national policy reforms and capacity development. However, if such policy frameworks are to have a real and pro-poor effect on the ground, they require that greater attention be given to developing local institutions and capacities for supporting low carbon development. This is especially important if adaptation and mitigation efforts are to be addressed jointly and from a more holistic perspective (Christoplos 2008). Such an approach does not imply a series of fragmented, stand-alone projects, but rather suggests a concerted effort to enhance local frameworks for low carbon development on the national scale, and applying both vertical (locality to central to locality) and horisontal (locality to locality) approaches to scaling-up. Such approaches can also help ensure that ownership of low carbon development is felt not only at the national level, but also to a greater extent in local institutions and among local stakeholders. The current emphasis on support to decentralization and local government development in many donor portfolios provide an important opportunity in this respect.

6.2 Recommendations for development cooperation in energy

Support alternative low carbon energy development at the local level

Access to energy is a prerequisite to achieving the MDGs and should therefore be high on the development assistance agenda for international aid agencies in the LDCs. As most rural poor in the LDCs live in settlements that are not connected to the national electricity grid, they depend on locally produced energy. Even though great plans are being made for national electrification in many developing countries, it will take decades before the majority of poor communities in LDCs have been connected to national grids. Donors can assist in developing and optimizing local low carbon energy-delivery mechanisms suited to local needs for clean and efficient cooking, lighting, education, health care and power for agriculture or other small enterprises.

Integrate local energy development with broader support to community development

Ensuring poor people's access to energy will not necessarily lift them out of poverty, and some people will still be too poor to be able to afford access to energy services, even if they are available in their own communities. It is therefore important to package energy development with broader support to community development activities, such as agricultural extension, education, health care and services for small-scale enterprise development.

Support the integration of differentiated energy development into national energy plans

Priorities and needs for energy development vary between different regions in a country. It is therefore important that national energy development plans realistically reflect the fact that the pace and nature of energy development will vary between different parts. This means that, even though the national long-term objective may be full electrification, development plans should incorporate short- and medium-term isolated energy development in dispersed rural settlements that will not be connected to the main grid within the next decades. Denmark's long tradition of decentralized energy production and of the gradual connection of these 'isolated' systems to the grid could be the basis for fruitful development corporation for decentralised energy development in LDCs.

Ensure the social and environmental integrity of large-scale energy projects

Not all low carbon energy development options are beneficial to the poor, and some carry the risk of being directly or indirectly harmful to the livelihood options of poor people if developed irresponsibly. Donors can support LDCs in developing criteria for socially and environmentally responsible energy development, in this case with particular focuses on hydro-power and biofuels. It is also important to ensure that energy development plans are adapted to current and predicted future changes in local climate. With hydro-power as the example again, it will be important to ensure that future water supplies are assessed as being sufficient for the projected hydro-power development, as well as for other water needs, both locally and further downstream.

6.3 Recommendations for development cooperation in agriculture

Combine an emphasis on practical options with a macro-focus

There is a need for a combined focus on practical options, with a macro-focus on policies and integrated approaches. In many cases, isolated climate-oriented programs and "add-on" policies will not be enough – there is also a need to address the macro-economic market conditions for agriculture, and to ensure that policies in other sectors (e.g. industry and the environment) are supportive of low carbon agriculture. Furthermore, agricultural mitigation measures often provide for synergies with sustainable development policies in general.

Develop institutional frameworks for pro-poor and low carbon multi-functional agriculture

Many LDC governments do not currently have the capacity required successfully to introduce and enforce environment policy instruments, taxation etc. Likewise, there is a need for support to institutional capacity development in environmental impact assessments of private and public agricultural investments.

Provide better options for soil management

Better options should be provided for soil management to enhance the carbon storage capacity and thereby also the water-holding capacity of the soil, including research and capacity development among extension staff. This will not only help on the mitigation side, it will also provide important adaptation benefits such as enhancing water efficiency and conservation.

Improve frameworks for biological pest control

Donor cooperation can help enhance the institutional capacity for pesticide control and regulation at the national and local levels to avoid the use of pesticides which are harmful not only in terms of their impacts on human health and the environment, but also in terms of in themselves constituting GHGs. If the aim is to avoid to the extent possible the use of pesticides, integrated pest-management approaches has in practice proved a risky strategy because, in practice, the focus continues to be on pesticide-based pest management. For this reason, an emphasis on biological pest management is preferable as a means of enhancing productivity, and human and environmental health in general, and in reducing GHG emissions in particular.

Support certification and demand for organic production

Attention should be given to supporting the capacity for and reducing the costs of organic certification of agricultural production, as well as stimulating the demand for organic certification. The only international standards relating to low carbon agriculture are those established for organic agriculture. Until and/or unless alternative 'low carbon' standards are developed, it is recommended to support the supply and thereby reduce the costs of organic certification as a mechanism that enables the compensation of agricultural producers for the climate change mitigation services they are providing through their agricultural products.

6.4 Recommendations for development cooperation in forestry

Expand the scope of REDD "preparation"
Through the FCPF, UN-REDD and other funds, much emphasis has recently been placed on ensuring the "readiness" of developing countries for REDD. Such preparation is good and important and could include modalities to ensure: (i) principles and regulations that inhibit perverse incentives; (ii) effective and inclusive enforcement and monitoring schemes; (iii) transparent national payment schemes; and (iv) accessible mechanisms for conflict resolution and independent legal advice for local stakeholders. There is, however, a need to avoid REDD-related funding to developing countries from becoming overly "mechanism-driven", and to increase the emphasis on addressing the actual drivers of deforestation (Brown and Bird 2008).

Support national forest policy reforms and frameworks
If REDD is to have any real effect in terms of poverty alleviation and longer-term national economic development, there is no way round the need for substantial policy reform in forestry sectors in many LDCs and other countries. This includes in particular the need to address and secure local forest rights, as well as policy reforms that take a cross-sectoral perspective. Support to such reforms can help meet some of the upfront investment costs that LDCs might otherwise not be able to bear, thereby also reducing the risk that governments will omit the time-consuming development of inclusive approaches and benefit schemes. It can also help deliver significant social, environmental and governance spin-off benefits beyond forestry, and will provide developmental benefits, even if the REDD mechanism were to fail.

Support local-level forest governance mechanisms
While some pilot efforts within community-based REDD are currently being undertaken on the ground, these have only addressed the local governance aspects of REDD to a limited extent. In particular limited attention has been paid to how REDD can be aligned and integrated with the general process of decentralization and local governance development. Importantly, support to local forest governance frameworks should not be focused merely on developing "REDD-capacity", but should rather aim at developing long-term, independent frameworks that include even the capacity to choose other approaches than REDD if so desired.

Promote Participatory Forest use and management in the REDD context
The potential of a "REDD Plus" approach that includes forest carbon-*enhancing* ac-

tivities such as forest restoration and sustainable forest management requires greater focus and demonstration on the ground. The potential for linking forest restoration to Participatory Forest Management seems obvious, especially in LDCs where forest degradation by local users is the key issue (rather than deforestation by external commercial operators). Given the importance and potential of small-scale forest enterprise development, such approaches also fit well with the increasing attention being given to employment creation in donor policies. Support to a REDD "Plus" model must, however, also ensure that the possibly negative impacts and perverse incentives associated with A/R are avoided.

Address international REDD design issues

While not the role of donor agencies per se, there is a need for national and international stakeholders in the REDD negotiation process to pay greater attention to the potential poverty consequences of international REDD design options. Addressing the poverty issue in REDD implies a greater emphasis on issues such as how and to what extent social standards and local rights issues can be incorporated into REDD, and how sustainable forest use and restoration by communities can be rewarded and accounted for. In this respect, a purely market-driven REDD mechanism that aims only at securing the most "buck for the bang" in terms of emissions and (cheap) credits is highly problematic – not just for the rural poor, but also for LDCs which, in many cases, would have great trouble competing on equal market terms.

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Annex A
International mechanisms for climate change mitigation

International mechanisms for climate change mitigation relevant to LDC

This Annex provides a brief discussion of the current international framework and mechanisms for climate change mitigation.

Carbon offsets and markets

In order to keep global temperature increases at a level at which impacts are still manageable, GHG emissions are required to peak in the next decade and decline to roughly 80% below 1990 levels by the year 2050 (IPCC 2007). Such dramatic CO_2 emissions reductions require a sharp move away from our dependency on fossil fuel, significant improvements in energy efficiency and substantial reorganisation of our current economic system. This transition can only be achieved by far-reaching national and international climate policies.

Among individuals, governments and companies who are striving to reduce their CHG emissions, carbon off-setting has become an increasingly popular means of taking action. By paying someone else to reduce GHG emissions elsewhere, the purchaser of a carbon offset (sometimes also referred to as carbon or CO_2 credit) aims to compensate for – or "offset" – their own emissions. Companies as well as individuals claim "CO_2 neutrality" when they buy carbon offsets to "neutralize" emissions from, for example, air travel. Governments and companies that are committed under international treaties to limit or reduce their emissions can also use off-sets to cover some of these commitments.

Carbon off-set markets can be divided in two groups: compliance schemes and voluntary programs.

Compliance markets are established and regulated by mandatory national or international carbon reduction regimes. The Kyoto Protocol and the European Union's Emissions Trading Scheme are such schemes under which the ratifying parties have committed themselves to specific CO_2 emission targets. The Clean Development Mechanism (CDM), as defined by Article 12 of the Kyoto Protocol, has the dual objective of assisting industrialized countries (and companies within them) to meet their quantified emission limitation and reduction commitments at the same time

as assisting developing countries to introduce new technology and achieve sustainable development goals. One of the key requirements is that the emissions reductions achieved under the project must be additional to any that would occur in the absence of the project and provide real, measurable and long-term mitigation benefits. The CDM is by far the biggest carbon market today, covering more than 90% of total carbon credit transactions in 2006. The current period of the Kyoto Protocol (and the CDM) will continue to 2012, and it is expected that an extension of this is going to be clarified during the Conference of the Parties (COP 15) in December 2009.

Voluntary off-set markets operate outside the compliance markets, enabling companies and individuals to purchase carbon offsets on a voluntary basis. The first voluntary off-set projects were created as early as 1989, nearly a decade before the compliance markets came into existence. Some of the most significant voluntary markets today are CCX (big in the US), VCS 2007 (new, but likely to be big), VER+ (small but growing) and CCBS (big for land-use change projects) (Kollmuss et al. 2008). Voluntary markets mainly attract individuals and companies from the USA, as their government has not ratified the Kyoto protocol and can therefore not participate in carbon trading under the CDM. The various voluntary markets jointly cover all of the same project types as the compliance markets, with the exception that most off-set projects in the forest sector have been developed under the voluntary market.

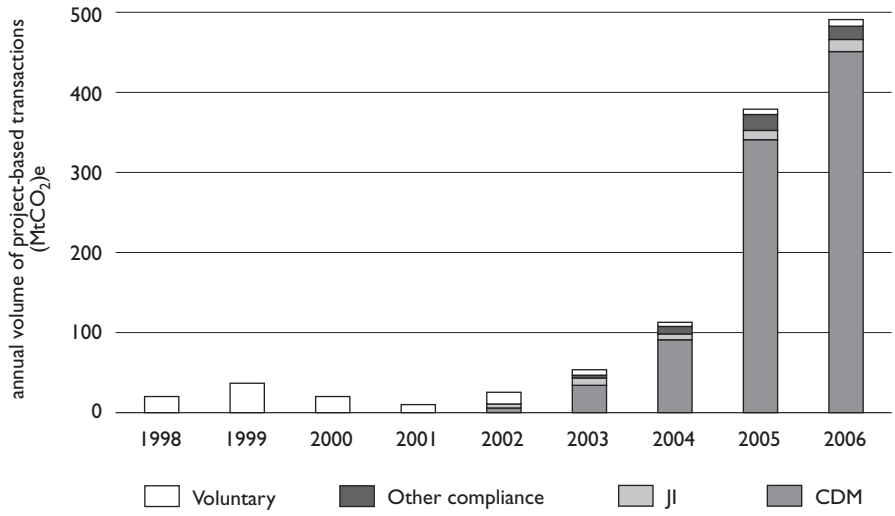
Table A1: Transactions of carbon credits by project type under the CDM and in the voluntary market

In %	Renewable Energy	Industrial gasses	Methane	Supply side EE	Demand side EE	Forest sector	Other
CDM (until 2012)	28,7	32	20	11	1	0,2	8
Voluntary (2006)	33	20	3	-	5	36	3

Source: UNEP/Risø 2008 and Hamilton et al., 2007

Carbon markets are already a substantial economic force, reaching transactions of nearly 500 million tons of CO_2 credits in 2006 with a value of more than €20 billion, and they are likely grow considerably over the coming years. The voluntary market, although it is only responsible for a small percentage of total carbon trading. is also growing rapidly (Estrada et al. 2008).

Figure A1: Annual volume of project-based carbon transactions



Source: Estrada et al, 2008

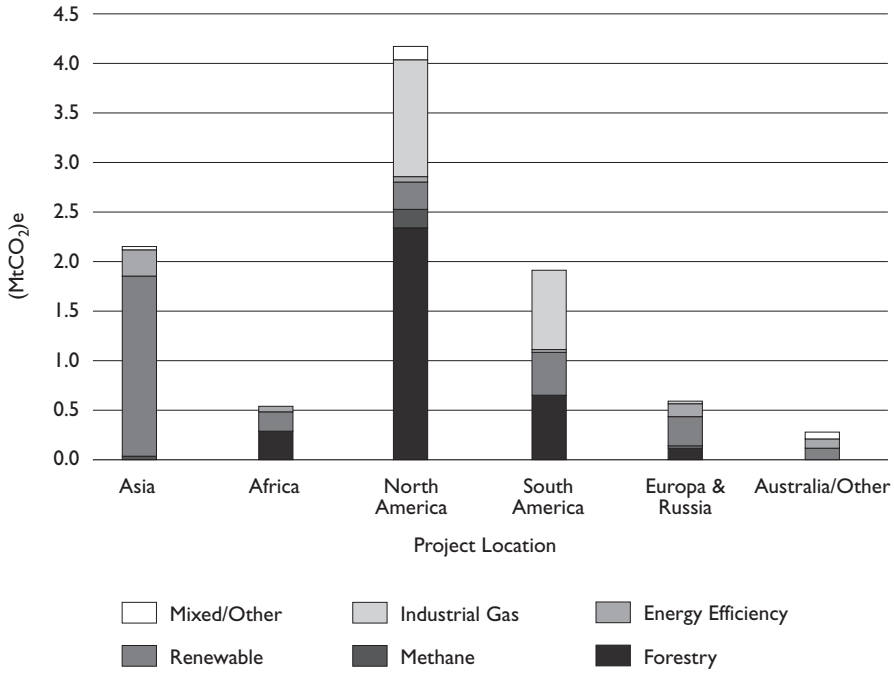
Carbon markets and development in the LDCs

Neither the CDM nor the voluntary markets have been very successful in stimulating a significant number of projects in LDCs. The main reason for this is probably that the carbon market is still new and under development, and that project developers have initially gone for the "big easy wins" where there have been big reduction potentials and where the capacity to plan and implement projects has been the highest. This "easy win" approach has automatically limited the focus on project development in the poorest developing countries, as none of the schemes have included a requirement that a fixed proportion of projects should come from certain regions or from the poorest developing countries. Instead it has basically been up to project developers and buyers to choose where they saw the biggest potentials.

Of the 4660 projects approved under the CDM, only 42 are located in LDCs (UNEP/Risø 2008), which makes these countries hugely underrepresented, including when compared to their proportion of the total GHG emissions of developing countries. Exact numbers of voluntary market projects in LDCs are not available, but an overview by region (see Figure A2 below) shows that less than 5% of carbon credits sold in these markets in 2006 came from Africa, and that Asia and South America each accounted for approximately 20%. Around half of all voluntary transactions come out of projects located in developed countries, mainly in North

America. Some voluntary markets seems to allow for greater participation by African countries, particularly through forestry projects (Estada et al. 2008), though these schemes still only capture a small percentage of the carbon market.

Figure A2: Voluntary market transactions by project location (2006)



Source: Hamilton et al. 2007

The emphasis in the off-set schemes on the social and environmental sustainability effects of projects greatly affects their relevance for low carbon development and poverty-reduction in LDCs. The sustainability aspect has been one of the main pillars in the design of the CDM. However, the Kyoto protocol puts the responsibility for ensuring that CDM projects promote sustainable development with the host country government. This has led to a wide range of definitions of what sustainable development is in this context. For example, the sustainability goals drawn up by Brazil emphasize employment and income distribution objectives, while Peru puts the priority to more general local community needs, and China's objectives have a stronger focus on promoting national economic growth over the local dimension of sustainable development. The identification of clear and sustainable development goals and indicators and the capacity to assess and monitor them are important

factors influencing the effectiveness of the CDM. Insufficient capacities are also a concern for NGOs and stakeholders participating in the assessment of projects during their validation.

Lohmann (2006) concludes that the CDM is not fulfilling its sustainable development objective, in part as a result of the uneven distribution of projects around the world and the prioritisation of emission reduction activities which do not necessarily have wider environmental benefits or a strong social component. Leaving the development and monitoring of the sustainable development aspects of the CDM projects to the host country has not proved a very effective way of achieving these objectives of the mechanism.

The requirements for the sustainable development aspects of projects also vary greatly among the voluntary market schemes. Some have no requirements regarding sustainable development (e.g. CCX, VCR and VER+), while others have been specifically established to promote links between the carbon market and aspects of sustainable development (e.g. CCBS and Plan Vivo). The latter, having a strong focus on community livelihood development aspects of their projects, still have to capture a significant part of the voluntary off-set market.

A recent comparative study of regulated versus voluntary carbon offset schemes by the Tyndall Center for Climate Change Research (Estrada et al. 2008) suggests that small-scale projects, which are often assumed to reach communities and small landowners in developing countries, occur almost in the same proportion in both schemes. But in absolute terms the CDM supports more of these projects. Although the voluntary market might be better at delivering sustainable development benefits to communities through forestry projects, most of these projects are located in the US, with only a few as yet in developing countries.

In conclusion, the contribution of carbon markets (compliance or voluntary) to sustainable development must be further strengthened to allow us to see these as a credible source of financing for low carbon development that also addresses poverty reduction and sustainable development in developing countries.

Annex B
Current financing for climate change mitigation in developing countries

This annex provides an overview of current major financing mechanisms and sources of finance relating to climate change in developing countries, and it briefly summarizes selected lessons learnt from multilateral and bilateral mitigation funding.

Overview of major financing mechanisms and sources of finance

A number of estimates exist of the funds required to achieve effective global emissions reductions. According to one UNFCC calculation, the investments needed to achieve a 25% reduction of global emissions by 2030 amount to some USD 200-210 billion (UNFCC 2008). By comparison, total ODA for all purposes (i.e. not just climate change) currently amounts to approx. USD 104 billion (op. cit.). Table B1 provides a breakdown of these estimates by sector, and the estimated share of this required in developing countries. It should be noted that the reduced fossil fuel costs are global and may thus not apply to individual countries. In LDCs, for instance, economic growth in LDCs may increase overall energy demand, and actual savings will therefore not be made on existing budgets, but would be in relation to alternative 2030 budgets if a policy of "business as usual" were pursued.

Table B1: Investment and financial flows required for 25% emissions reduction by 2030

Sector	Areas/mitigation measures considered	Global cost (2005 USD billion)	Proportion needed in developing countries (%)
Fossil fuel supply	Lower production due to reduced demand and greater use of biofuels	-59	54
Power supply	Lower fossil-fired generation capacity More renewables Carbon dioxide capture and storage Nuclear energy Hydropower	-7	49
Industry	Greater energy efficiency Carbon dioxide capture and storage Reduced emissions of non-CO_2 gases	36	54
Buildings	Greater energy efficiency	51	28

continues

Sector	Areas/mitigation measures considered	Global cost (2005 USD billion)	Proportion needed in developing countries (%)
Transportation	More fuel-efficient vehicles Greater use of biofuels	88	40
Waste	Capture and use of methane from landfills and wastewater plants	1	64
Agriculture	Reduced methane emissions from crops and livestock	35	37
Forestry	Reduced deforestation and forest degradation Sustainable forest management	21	99
Technology research, development and deployment	Double the amount that is currently spent in this area	35-45	
Total net additional investment		**200-210**	

Source: UNFCC 2008: 18

Current public financing for the innovation of new emissions reduction technologies and approaches are estimated in Table B2. The R&D efforts costing USD 10 billion mainly consists of the government funding provided by developed countries for their own purposes. The remaining funding includes the major current sources of public financing for climate change mitigation in developing countries.

Table B2: Estimated total available sources of public financing for innovation of mitigation technologies and practices (globally, as of November 2008)

Stage of technological development at which financing is applied	Source	Estimated average annual investment (USD billion)
	Sources outside the Convention	
Research and development, demonstration	Government funding	10
	Sources under the Convention	
Deployment, diffusion	Financial mechanism under the Convention (Global Environment Facility Trust Fund, Special Climate Change Fund, Least Developed Countries Fund)	0.22-0.32
Deployment, diffusion	Kyoto flexibility mechanisms (clean development mechanism, joint implementation)	4.5-8.5
	Sources outside the Convention	
Diffusion	Export credit agencies	1-2a
Deployment, diffusion	Bilateral and multilateral sources	5-10a
Deployment, diffusion	Philanthropic private sources (including non-governmental organizations, foundations and voluntary carbon market finance	1

Source: UNFCC, Nov. 2008: 70 (a) The estimates cover only dedicated Low Carbon financing options.

The Convention on Climate Change and its Kyoto protocol provide a number of these funding sources. Under the Kyoto protocol, climate funding is provided under the CDM, the Joint Implementation and the Adaptation Fund. Only the former is relevant to mitigation in LDCs (as the JI caters for Annex I countries). Also under the Convention, the Global Environment Facility (GEF) administers three major funds, namely the GEF Trust Fund on Climate, the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund. The latter gives priority to adaptation and NAPA development, while the SSCF and the GEF Trust Fund supports technology transfers and mitigation management in a range of sectors, including agriculture, energy, forestry etc.

In the past two years, a number of major new multilateral and bilateral funding initiatives have emerged for support to climate change mitigation and adaptation efforts in developing countries.

Table B3: Major multilateral funding sources for mitigation and adaptation

Fund	Total amount (US$)	Type of funding	Period	Source of funds	Comments
FCPF (WB)	165 million, of which 91 million: Readiness Fund 74 million: Carbon Fund	Grants	2008-2012	The United Kingdom and Germany have contributed to both the Readiness Fund and the Carbon Fund; the Nature Conservancy only to the Carbon Fund; six other countries only to the Readiness Fund.	Minimum contribution to participate is $5 million for both governments and private sector entities.
TFA (GEF)	60 million	Grants	2008-2010	GEF Global and Regional Exclusion funds ($30 million from the biodiversity allocation, $10 million from the climate change allocation) and $20 million from the land degradation focal area.	
CTF (WB)	Uncertain	Concessional financing, blended with MDB financing, as well as bilateral and other sources of finance	2008-2012	UK and Japan. Uncertainty prevails regarding contributions from the United States and other donors.	
Earth Fund (GEF-IFC)	200 million	Grants, concessional loans and innovative funding tools	2008-[?]	GEF has allocated $50 million and hopes to obtain 150 million in co-financing from private-sector entities.	Innovative funding tools include venture capital, prizes, and other tools that reward innovation.
SCF and its PPCR	Up to 1 billion	Grants and highly concessional loans	2008-2012 (PPCR)	PPCR pledged by end Jan. 2009: $ 240 million, with additional funds anticipated	
Kyoto Adaptation Fund	Not known	Grants	No start date announced	A 2 percent levy on the emission permits generated under the Kyoto Protocol's Clean development Mechanism.	The exact level of funding is not yet known, because it will depend on the demand and price of reductions on the carbon market.
Total Multilateral Funding	**Less than 2 billion**				

Source: Updated from Porter et al. 2008, using date from www.climatefundsupdate.org. Note: CTF = Clean Technology Fund; FCPF = Forest Carbon Partnership Fund; GEF = Global Environment Facility; IFC = International Finance Corporation; MDB = Multilateral Development Bank; PPCR = Pilot Program for Climate Resilience; TFA = Tropical Forest Account; WB = World Bank

Details of the various initiatives can be found in Porter et al. (2008). Of the above funds, a number provide funding for LDCs through their general thematic focus, but only one is targeted specifically at LDCs in terms of mitigation. This is the EU-funded Global Climate Change Alliance (GCCA), which includes funds for forest carbon work, CDM capacity development and integration, although its main priorities lie with adaptation and disaster risk reduction. A number of funds relevant to the forest sector and REDD in particular have also recently been developed.

Table B4: Major bilateral funding sources for climate change mitigation and adaptation

Fund	Currency	Total amount	U.S. dollar equivalent[a]	Period	Nominal annual level	Comments
Japanese Cool Earth Partnership	USD	10 billion	10 billion	2008-2012	2 billion	
ETF-IW of the United Kingdom	GBP	800 million	1,593 million	2008-2010	531 million	
Norwegian NORAD Rainforest Fund	USD	560 million	560 million	2008-2012	112 million	
Spanish MDG Fund	Euro	90 million	143 million	2008-2011	36 million	
GCCA of the European Commission	Euro	50 million	79 million	2008-2010	26 million	Refers to earmarked commitment from the ENRTP; additional funding may be forthcoming
German International Climate Initiative	Euro	400 million per year	634 million per year	Uncertain	184 million (international component)	30% of this funding will be used to finance climate change projects
Australian GIFC	AUD	200 million	188 million	Uncertain	Uncertain	
Total Bilateral Funding					**Less than 3 billion**	

Source: Porter et al. 2008: Note: AUD = Australian dollar; ENTRP = Environment and Natural Resources Thematic Programme; GBP = British pound; USD = U.S. dollar

Challenges and lessons learnt from multilateral and bilateral mitigation funding

The CDM mechanism and voluntary carbon markets are briefly discussed in Annex A. With respect to donor-funded financing, a review of the literature indicates a number of problematic issues in the current proliferation of available climate change funding:

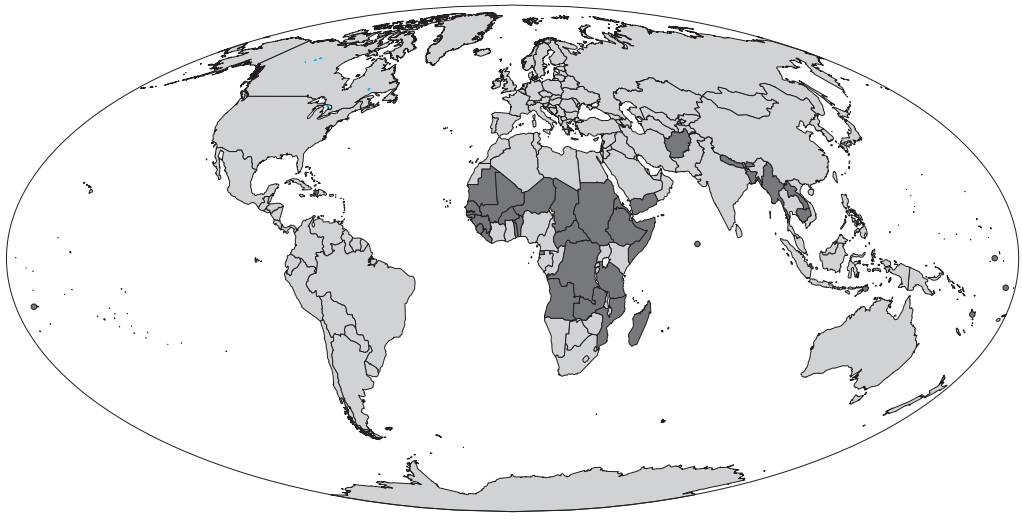
- The different sources of both multilateral and bilateral funding for mitigation are largely uncoordinated and tend to be directed towards "hot" issues and countries with high potential. There is relatively little funding specifically targeted at LDCs in terms of mitigation, which poses the risk that these countries will lose out to other, more competitive or more attractive countries, as has been the case with the CDM.
- Some donor portfolios reflect an ambiguous relationship with climate change mitigation, providing funding to both high-carbon and low carbon development at the same time. For instance, the World Bank's lending portfolio continues to reflect an emphasis on conventional fossil fuel development (Porter et al. 2008). It is understood that some such development may continue to be required in developing countries, but a more strategically coordinated approach is needed to avoid inconsistencies in support to low carbon development. Likewise, there has been a tendency to address adaptation and mitigation as separate issues, with limited attention to the inter-linkages between them. Some donors, however, are currently developing strategies that suggest a more holistic approach, including the World Bank's Strategic Framework on Climate Change and Development (World Bank 2008a).
- Donors seeking to support the poverty aspects of climate change mitigation may in some cases find themselves pursuing different agendas than other branches of their governments. For instance, Schmidt (2008) predicts that the negotiation of an international mechanism for Reduced Emissions from Deforestation and Degradation (REDD) will pose inconsistent agendas between development agencies wishing to promote pro-poor approaches and EU Governments wishing to ensure cheap and efficient carbon credit mechanisms. Coordinated national negotiation objectives that include poverty issues in national negotiation objectives are therefore crucial, as is support to the capacity development of LDCs to promote poverty issues in such negotiations (as currently undertaken by IIED).
- Representation of LDC and other developing country partners in the governance or steering of the multilateral funds for mitigation has been weak in some

cases. For instance, in the Clean Technology Fund, critics have pointed out that final the decision-making power over allocations remains exclusively with the funders. Likewise, civil society organizations have complained about a lack of representation of Indigenous Peoples in the Forest Carbon Partnership Facility. In the latter case, however, steps have recently been taken to address this shortcoming by involving IP representatives in the dialogues, as well other efforts to engage CSOs.

These various problems reflect the highly politicized nature of climate change funding and the danger in assuming that poverty issues and LDC needs are automatically addressed in mitigation funding. On the bright side, increasing attention to poverty issues is evident in the objectives and aims of mitigation funding, as is the notion that low carbon development may also be relevant to LDCs. It is also important to note that a number of ongoing and practical options already exist in developing countries and are being applied by national governments on smaller or larger scales, ranging from urban mitigation strategies in Bangkok via participatory forest management in Tanzania to new public transport systems in Bolivia. These suggest a need to look beyond a solely North-South perspective towards also exploring options for greater South-South collaboration in low carbon development.

Annex C
List of Least Developed Countries

Least Developed Countries (LDCs)



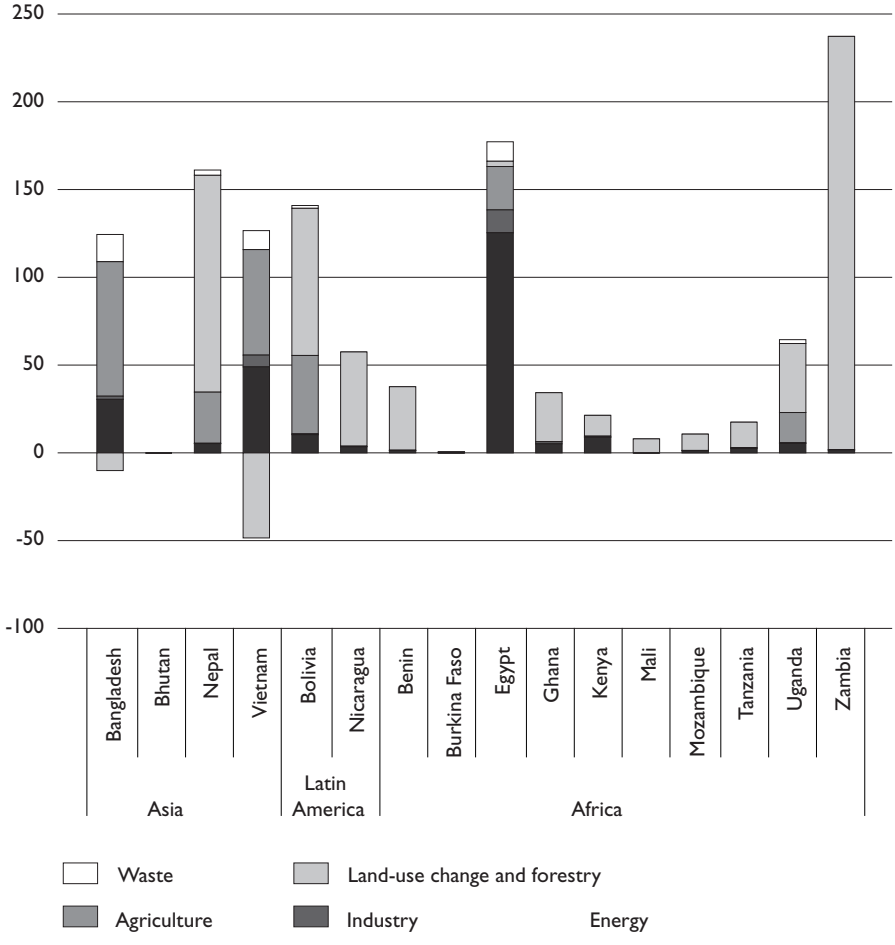
1 Afghanistan	14 Djibouti	27 Malawi	40 Solomon Islands
2 Angola	15 Equatorial Guinea	28 Maldives	41 Somalia
3 Bangladesh (*)	16 Eritrea	29 Mali (*)	42 Sudan
4 Benin (*)	17 Ethiopia	30 Mauritania	43 Timor-Lesté
5 Bhutan (*)	18 Gambia	31 Mozambique (*)	44 Togo
6 Burkina Faso (*)	19 Guinea	32 Myanmar	45 Tuvalu
7 Burundi	20 Guinea-Bissau	33 Nepal (*)	46 Uganda (*)
8 Cambodia	21 Haiti	34 Niger	47 Un. Rep. of Tanzania (*)
9 Cape Verde	22 Kiribati	35 Rwanda	48 Vanuatu
10 Central African Republic	23 Lao PDR	36 Samoa	49 Yemen
11 Chad	24 Lesotho	37 São Tomé and Principe	50 Zambia (*)
12 Comoros	25 Liberia	38 Senegal	
13 Democratic Republic of the Congo	26 Madagascar	39 Sierra Leone	

Source: http://www.un.org/special-rep/ohrlls/ldc/list.htm [accessed 10/03 2009]

(*) Danida Programme countries

Annex D
GHG Emissions for Danida Partner Countries and Denmark

Figure D1: GHG Emissions for Danida Partner Countries, Total in 2000 (Million metric tonnes)

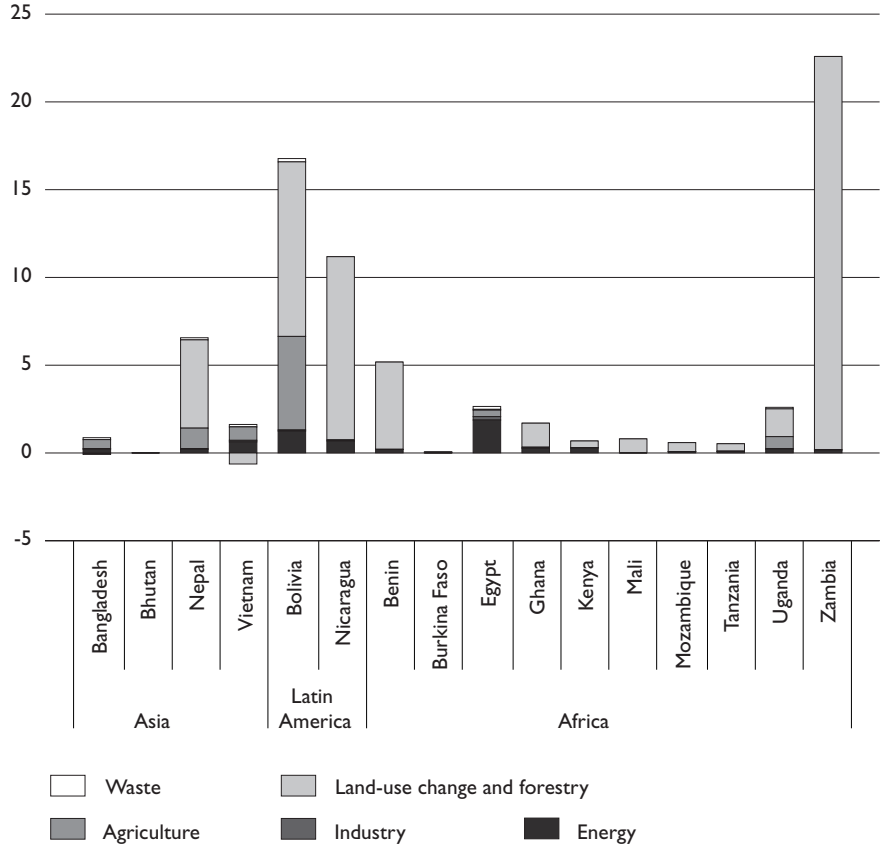


Source: WRI Climate Analysis Indicators Tool, using 2003 data (accessed 22 March 2009)

Notes:

- Data from some sectors for some countries are not available.
- The unusually high land-use change emissions from Zambia should be taken with some caution. See comments to Table D3 below.

Figure D2: GHG Emissions for Danida Partner Countries, Per Capita in 2000
(Million metric tonnes per capita)

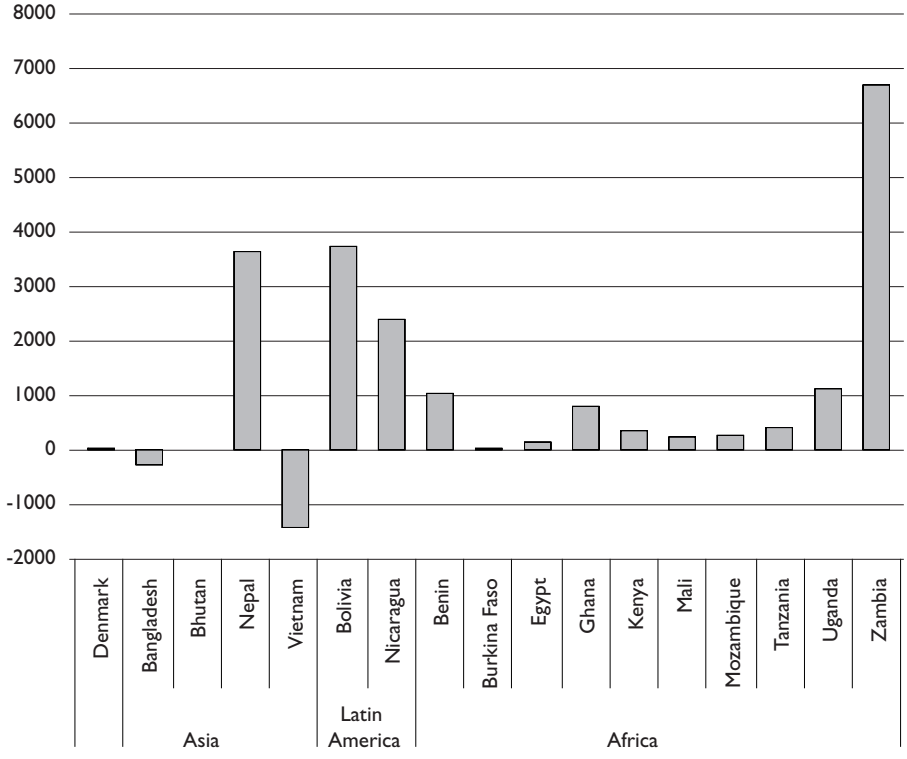


Source: WRI Climate Analysis Indicators Tool for emissions, and WRI World Development Indicators database using 2000 data for population (accessed 22 March 2009)

Notes:

- Data from some sectors for some countries are not available.
- The unusually high land-use change emissions from Zambia should be treated with some caution. See comments to Table D3 below.

Figure D3: GHG emissions from land-use change and forestry in selected Danida partner countries, cumulative for the period 1950-2000



Source: WRI Earthtrends database (accessed 22 March 2009)

Notes:

- Data from Bhutan are not available.
- The data include "emissions from living and dead vegetation disturbed at the time of clearing or harvest, emissions from wood products (including fuelwood), and emissions from the oxidation of soil organic matter in the years following initial cultivation. Those ecosystems that are not directly affected by human activities such as agriculture and forestry are not included in these estimated sources and sinks" (from Technical Notes to the WRI Earth trends database).
- The unusually high land-use change emissions from Zambia should be treated with some caution. While usually attributed to the extensive deforestation and degradation in that country, they do not compare well with countries that are believed to have experienced similar forest trends, such as Tanzania. Some experts consulted believe the Zambian data may be a result of errors in emissions reporting.

Annex E
Rationales for scoring of options in energy

Note: the score is an indicative assessment for use in the spider diagrams in the main report

Theme	Improved cooking fuels and stoves		
Option/technology	Biogas production from household waste and livestock manure	Improved biomass stoves	More efficient wood coal
Pro-poor livelihood potential	3 Improvement of health through providing cleaner cooking facilities Reduces time for traditional fuel collection, opening up opportunities for education or income-generating work		
GHG emission reduction	3 By capturing methane from manure and waste Reducing collection of wood	2 Reducing collection of wood	
Local environment benefits	3 Can reduce organic water pollution from waste/manure Alternatives to wood can reduce stress on local forest resources	2 Can reduce some stress on local forest resources by improving efficiency of biomass extracted from the forest.	
Economic growth potential	1 No direct impact on national economic growth		
Maturity of technology	2 – 4 Well tested technology for small scale farms in Southeast Asia – questionable if applicable to production modes in Africa	4 Well-tested technology – commercial distribution many places in Africa	3 Well-tested technology
Initial investment and maintenance cost	2 Relatively cheap initial investments (different models with different capacities)	3 Available at affordable priced in many countries	3 Capacity-building costs for local providers

continues

Theme	Mechanical power at community and household level	Electricity production at community and household level
Option / technology	Combinations of small scale wind, solar and treadle pumps, often with diesel generator as back-up	Small scale PV (photo voltaic - solar panels), hydro and wind for electricity production
Pro-poor livelihood potential	4 'Off grid' mechanical power can provide energy for a variety of machines (water pumps, husking, grinding, sawing) which can: - enable poor households to generate income - ease agriculture processing, access to water and other labour intensive and time consuming tasks - create employment opportunities in small scale enterprises	3 Access to reliable electricity at community level can: - improve health services - enable studying and income-generating activities outside daylight hours - enable use of information and communication technologies - attract professionals like doctors, teachers and extension workers to the community
GHG emission reduction	3 Will reduce CO_2 emissions through reduced use of diesel – but at a relatively small scale	3 As to the left
Local environment benefits	2 Alternative income activities can also reduce hunting and logging indirectly benefiting local biodiversity	2 As to the left
Economic growth potential	3 Providing energy for productive uses in rural areas can spark local business development and economic growth which will feed into overall national growth	3 Access to electricity at local level can spark local business development which will feed into general economic growth
Maturity of technology	3 Technology is well tested, though cheap PV and wind models (from e.g. china) can have problems with durability	3 As to the left
Initial investment and maintenance cost	2 Relatively high initial investment costs, but becoming cheaper in comparison with fossil fuel generated energy Could be financed through community loans and individual user re-payment schemes	3 Relatively high initial investment costs, but becoming cheaper in comparison with fossil fuel generated energy

continues

Theme	Electricity production on large scale – distributed through grid
Option / technology	Large-scale renewable: - Wind power - Hydro power - PV Geothermal energy Biomass for cogeneration in power plants Large-scale biogas from livestock manure or landfill methane capture
Pro-poor livelihood potential	2 Questionable how poor people can directly benefit from large scale energy produces as it is distributed via the electricity grid, which most poor do not have access to. If provided to poor communities through the grid, at affordable price, it will have the same benefits as 'off the grid' electricity production above Large constructions like hydro dams could in some areas reduce poor people's livelihood options
GHG emission reduction	4 High potentials for GHG reduction by substituting fossil fuels in electricity production
Local environment benefits	3 Generally friendly to the environment. However, large constructions such as dams for hydro-power can have negative local environmental impacts by obstructing natural environmental flows.
Economic growth potential	4 Large-scale reliable energy provision is a pre-requisite for economic development Reliable renewable energy and reduced dependency on imported fossil fuels can have significant impacts on national economic stability
Maturity of technology	3 The right natural conditions are pre-requisites for the efficiency of all of these technologies Some, like hydro and wind, have been proved at commercial scale through decades. For others, new more efficient generations of technologies (ex-PV) will soon be available commercially.
Initial investment and maintenance cost	1 All of these technologies require large-scale investments – the repayment time varies between the different technologies and the local potentials for optimising the potentials of the technology

continues

Theme	Energy for and efficiency in transport	
Option / technology	Biomass based fuels for transportation (from e.g. jatropha, sugar and other agricultural crops)	Bus rapid transport (BRT) systems
Pro-poor livelihood potential	1 Can have negative impact on poor people's access to land	2 Reduced urban transportation times and improved security can give poor people better access to markets, healthcare, information, education etc.
GHG emission reduction	4 The transport sector is a main CO_2 emitter – efficiency measures and replacement of fossil fuels will have substantial impact	4 Emissions reductions through switch from private cars and micro-buses to larger more fuel-efficient buses
Local environment benefits	1 Can lead to increased demand for agricultural land, which again leads to increased pressure on marginal lands and forest conversion	4 Significant reductions in local air and noise pollution along main traffic corridors
Economic growth potential	3 Will limit dependency of imported fossil fuels for many developing countries and create a new domestic industry with jobs and investments	3 Will improve access to economic centres and significantly reduce time in traffic.
Maturity of technology	3 First-generation bio-fuels are used extensively - more efficient second- and third-generation bio-fuel technologies are under development	4 BRT systems are in successful operation in many cities in developing countries
Initial investment and maintenance cost	3 Investments in further technology development and build up of domestic capacity	3 Some initial infrastructure investments needed, but much cheaper than other mass transport systems and operations can be privately run

Annex F
Rationale for scoring of options in agriculture

Note: the score is an indicative assessment for use in the spider diagrams in the main report

Score 1-4 where 4 is best	Minimum tillage farming	Integrated soil (fertility) management	Biological pest control
Pro-poor livelihood potential	4 Identifying viable and low external input alternatives to mechanical ploughing of land will benefit pro-poor farmers who are often constrained by lack of access to ploughing at the optimal time due to lack of equipment and/or draught animals and/or cash to pay for this service at the optimal time.	3 Integrated soil fertility management seeks to reduce the dependency on synthetic fertilizers for soil fertility management while relying on more labour- and knowledge-intensive techniques. If properly remunerated – made possible e.g. by payment of low carbon and/or organic certification premium – such techniques build upon the resources available in poorer rural households (labour and agricultural knowledge) while avoiding or at least reducing dependence upon cash outlays. Moreover, integrated soil fertility management techniques provide higher yield stability in cases of low and variable rainfall (higher soil moisture contents) than conventional agriculture.	4 Smallholders using alternative pest management methods, such as biological control, are not only more climate friendly than farmers using pesticides; they also avoid the costs, the indebtedness and the health problems that often follow the use of pesticides. Adopting biological pest control techniques which avoid the use of chemical pesticides thus improves the livelihood of farmers as well as rural (and urban) dwellers in general.

continues

Score 1-4 where 4 is best	Minimum tillage farming	Integrated soil (fertility) management	Biological pest control
GHG emission reduction	3 Agricultural systems differ in their capacity to produce eco-efficiently. Energy-wise, for instance, Conforti and Giampietro (1997) compared output-input (O-I) ratios of 75 countries world-wide and found O-I ratio variations from 156 to 0.41 ! The countries shown to have the most inefficient agriculture (O-I ratios < 2) included mostly rich countries. The countries seen to have efficient agriculture (ratios > 30) included Ghana, Niger and Uganda. Part of the explanation for this difference is the much lower levels of mechanization in the South. Conforti, P. and Giampietro, M. (1997) Agriculture, Ecosystems and Environment 65:231-243.	4 Use of synthetic fertilizer often adds to the major problem of evaporation of nitrous gasses – which are potent GHGs, 300 times stronger than CO_2. Moreover, by reducing the use of synthetic fertilizers, the emissions related to its production and transport are also avoided. Finally – and in an LDC context characterized by low levels of fertilizer use, perhaps most importantly – by adopting alternative soil fertility management strategies to that of (solely) relying on synthetic fertilizers, the carbon storage capacity of the soil is enhanced, which offsets CO_2 emissions.	4 Avoiding emissions of chemicals such as sulfyryl fluoride has a very high GHG reduction potential – recent research suggests 4800 times stronger than CO_2 in terms of climate change effect. Such knowledge about the global warming effects of pesticides as GHGs is still incomplete, which implies that agriculture's direct contribution to climate change currently may be underestimated. In addition to avoiding direct emissions associated with pesticide application, avoiding the use of chemical pesticides also reduces the GHG emissions associated with pesticide production and transport.

continues

Score 1-4 where 4 is best	Minimum tillage farming	Integrated soil (fertility) management	Biological pest control
Local environmental benefits	2 The major environmental benefit of avoided fossil energy may materialize at the global level; locally benefits may include avoided air pollution and avoided pollution of water.	3 Improved soil quality, including improved soil water holding capacity The major environmental benefit of avoided fertilizer use may materialize at the global level; locally benefits may include avoided air pollution and avoided pollution of water.	4 Local benefits are high, for instance in terms of improved human health, improved biodiversity, and avoided poisoning of non-target species and water bodies.
National economic growth potential	2 Minimizing use of fossil fuels will impact this measure both downwards and upwards, in different areas.	4 Avoiding synthetic fertilizers will impact this measure both downwards and upwards, in different areas.	2 Avoiding chemical pesticides will impact this measure both downwards and upwards, in different areas, with an overall positive outcome if intelligent policies are implemented.
Initial investment costs (1= high cost, 4= low cost)	3 If soil structure is maintained through biological techniques rather than through the use of chemical inputs (e.g. herbicides), then initial investment costs are primarily public investment costs in adaptive research and/or extension.	3 Since most poor smallholders are already avoiding (the cost of) synthetic fertilizers, this measure does not imply initial investments. However, in order to improve soil quality and in particular soil fertility, alternative soil fertility improvement techniques are needed. Many of these techniques are known, but often there is a need for public investments in adaptive research and/or extension.	2 It will take moderate costs to stimulate the innovation and production system to develop and disseminate environmentally sustainable pest management methods such as biological control.
Maturity of technology/ approach	4 Minimum tillage techniques abound in the tool boxes for so-called 'low external input agriculture', 'conservation agriculture', 'agroforestry', 'organic agriculture methods, permaculture, etc.	2 While materials and technologies exist to substitute for synthetic fertilizer, these alternatives are often either expensive and/or labour-intensive. There is an underexploited potential for innovation and development of alternatives that are more efficient in terms of cost, particularly labour intensity.	2 There is an underexploited potential for innovation, development and dissemination of pest management alternatives such as biological control.

Annex G
Rationale for scoring of options in forestry/REDD

Rationale for scoring of options in REDD

Note: the score is an indicative assessment for use in the spider diagrams in the main report

Score 1-4 Where 4 is best	Avoided Deforestation	Avoided Degradation	Afforestation/ Reforestation	Forest Restoration (with SFM)
Pro-poor livelihood potential	2 Low income potential where poorest are not involved in land clearing; possible loss of jobs in logging sector May be practically and technically difficult to compensate for avoided small-scale land clearing, e.g. cyclical cultivation Potential indirect benefits from sustained/ improved ecosystem services	3 As for Avoided Deforestation if emphasis is sustainable logging If linked to Forest Restoration, may have greater pro-poor potential through SFM/ PFM and benefit sharing	3 Some labour opportunities in plantations. Enhanced incomes from agro-forestry crops Investment costs may exclude the poorest Negative environmental impacts from poor planning may hit poorest hardest	4 Good scope for enhanced local forest use and benefit-sharing (if undertaken as SFM) PFM approaches can help strengthen non-economic livelihood aspects (rights, voice) Poorest may not necessarily benefit if local governance is not transparent/does not involve poorest
GHG emission reduction	4 High potential, as land clearing is a major source of forest emissions, but only in LDCs where deforestation is a major issue Leakage risk high if project-based Requires strong governance and control to be effective. May be a problem in some LDCs	3 Good potential in some LDCs, especially if combining RIL with Forest Restoration. Methodological difficulties in monitoring and accounting for Avoided Degradation may be a particular problem for low capacity LDCs	3 Good potential. Geographical scope differs according to means of calculation in assessments. Some find less potential in Africa. Leakage risk high if afforestation leads to increased demand for land (e.g. cutting natural forest)	3 Good potential. Arrests negative change (i.e. Avoided Degradation) and enhances positive change Leakage problems lower in subsistence oriented forest restoration (according to IPCC) Dry forest emission reduction potential still not well understood. Lower carbon density, but covers significant spatial area in e.g. Africa

continues

Score 1-4 Where 4 is best	Avoided Deforestation	Avoided Degradation	Afforestation/ Reforestation	Forest Restoration (with SFM)
Local environmental benefits	4 Preserves biodiversity-rich primary forest. Sustains existing forest ecosystem.	4 Preserves biodiversity-rich primary forest. Naturally restores existing forest ecosystem.	2 May enhance ecosystem services through e.g. watershed conservation Stands/plantations typically low-biodiversity, and foreign species may have negative impacts Risk of perverse incentives to replace primary forest with A/R if not regulated in REDD Leakage risk high if afforestation leads to increased demand for land (e.g. cutting natural forest)	3 Restoration of ecosystem functions. Biodiversity partly restored Leakage problems lower in subsistence oriented forest restoration (according to IPCC)
National economic growth potential	3 Share of benefits for some LDCs may be limited if "big" forest countries dominate (e.g. Brazil, Indonesia) Fair prospects for some LDCs (e.g. Congo basin), provided opportunity costs are exceeded by carbon prices	3 As for Avoided Deforestation Particular methodological difficulties in monitoring and accounting for Avoided Degradation could mean investors avoid low-capacity LDCs in this category	2 May increase potential for some LDCs but requires finance and capacity Can support Forest SMEs and employment, which form important part of local forest industry in many countries Biggest emissions reduction scope for A/R is in Asia and Latin America. African LDC prospects more limited.	2 May improve prospects for LDCs with high degradation/low deforestation (depending on baseline used). Can support Forest SMEs and employment, which form important part of local forest industry in many countries Could increase potential for LDCs with extensive dry forests – but depends on carbon potential of dry forests

continues

Score 1-4 Where 4 is best	Avoided Deforestation	Avoided Degradation	Afforestation/ Reforestation	Forest Restoration (with SFM)
Initial investment costs (1= high cost, 4= low cost)	2 Initial, upfront investment costs relatively high for national capacity development in methodologies, increased enforcement etc. Could be a problem for LDCs, especially if ex post payment principle is applied in a global carbon market	2 As for Avoided Deforestation (possibly lower cost if undertaken through Forest Restoration)	2 National and private A/R programmes often have relatively high initial investment costs, especially if land is factored in	3 Relatively low investment costs (depending on extent of degradation of forest), especially if undertaken through PFM Some transaction costs may be higher compared to Avoided DD if PFM is applied because of necessary site-by-site approach
Maturity of technology/ approach	2 Still to be seen if payments for avoided logging/land clearing can actually off-set the extensive opportunity costs for governments and private sector	2 Unclear if Avoided Degradation is effective if it is only focused on selective logging with no benefits to forest dependent communities. RIL and other approaches emerging.	3 Broad experiences (good and bad) from a range of contexts Effect on emissions still only partly understood	2 Some experiences (good and bad) from a range of contexts Effect on emissions still only partly understood Requires strong governance systems if applied in PFM context, which is not always present

Annex H
List of people consulted and workshop/seminar participants

Resource persons consulted

Javier Gonzales Iwansiw	Stockholm Environment Institute/Nur University, Bolivia
Ishmael Edjekumhene	Kumasi Institute of Technology and Environment, Ghana
Jacob Mwitwa	Copperbelt University, Zambia
Leo Peskett	ODI, UK
Jessica Brown	ODI, UK
David Brown	ODI, UK
Hannah Reid	IIED, UK
David Satterthwaite	IIED, UK
Ian Johnson	IDEAcarbon, UK
Jeff Tullberg	Australian Institute of Agricultural Sciences
Ivan Nygaard	Risø DTU
Gordon Mackenzie	Risø DTU
Anders Hauch	Confederation of Danish Industry (DI)
Finn Danielsen	Nordeco
Troels Dam Christensen	Danish 92-Group
Poul Erik Lauridsen	Care Denmark
Morten Fauerby Thomsen	Care Denmark
Christina Nilsson	IWGIA
Kresten Kjær Sørensen	Organisation for Sustainable Energy (OVE)

External seminars and conferences attended during the study:

- *Conservation Agriculture Carbon Offset Consultation,* Bech Agricultural Center, West Lafayette, Indiana USA, October 28-30, 2008
- *What is the fast track to future energy systems with lower CO2 emissions? Workshop on Future Energy Systems*, Technical University, Lyngby, Denmark, November 19-20, 2008
- *International Scientific Congress on Climate Change,* Copenhagen, March 10-12, 2009
- *Poverty, Forests and Climate Change: Practical Strategies for Ensuring Pro-Poor Approaches to REDD*, Copenhagen, April 21, 2009

PROGRAMME FOR PUBLIC SEMINAR ON LOW CARBON DEVELOPMENT AND POVERTY REDUCTION

Opportunities and Challenges for Development Assistance

Tuesday, 13 January 2009, 09.00-16.00

09.00-09.05	**Welcome**
09.05-09.15	**Low Carbon Development in Low Income Countries: Linking to Poverty Reduction** *Jacob Fjalland*, Research Assistant, DIIS *Mikkel Funder*, Project Researcher, DIIS
09.15-09.45	**Considerations on Low Carbon Development – Perspectives from Bolivia** *Javier Gonzales Iwansiw*, Environment and Development Researcher, Stockholm Environment Institute in Oxford, UK, and Nur University, Bolivia
09.45-10.15	**Making REDD work for the poor** *Jessica Brown*, Research officer, Overseas Development Institute (ODI), UK
10.15-10.45	**Organic Farming in Low Income Countries: An Example of Pro-Poor Low Carbon Development?** *Henrik Egelyng*, Project Researcher, DIIS
10.45-11.00	**Coffee Break**
11.00-11.30	**Low Carbon Energy Development and Poverty Reduction in Sub-Saharan Africa: Opportunities and Barriers** *Ishmael Edjekumhene*, Senior Program Manager, Kumasi Institute of Technology and Environment (KITE), Ghana
11.30-12.00	**The Role of Existing SMEs in Developing Low Carbon Energy in Africa: The Case of the MFP Programme in West Africa** *Ivan Nygaard*, Scientist, Risø DTU National Laboratory for Sustainable Energy, Roskilde, Denmark
12.00-12.30	**Is There a Market for Danish Companies in Low Carbon Solutions for Low Income Countries?** *Anders Hauch*, Regional manager, Confederation of Danish Industry (DI)
12.30-13.15	**Lunch**
13.15-15.00	**Facilitated Discussions in Two Parallel Sessions** **Session 1:** Energy – facilitated by *Gordon Mackenzie*, Senior Scientist, Risø DTU National Laboratory for Sustainable Energy, Roskilde, Denmark **Session 2:** Forestry / Agriculture – facilitated by *Poul Erik Lauridsen*, Programme Coordinator, Care Denmark
15.00-15.45	**Presentation and Plenary Discussion of Key Points from Break-out Groups**
15.45-16.00	**Closure of Conference**

List of participants at public seminar on Low Carbon Development and Poverty Alleviation, DIIS 13/01 2009 *(excluding presenters)*

Firstname	Surname	Title	Organisation
Torsten	Malmdorf	Cand. Scient.	Danish Energy Agency
Mette Lund	Sørensen	Adviser	DanChurchAid
John	Avery	Associate Professor Emeritus	University of Copenhagen
Anette	Schou	MH.	Europabevægelsen
Kjeld A.	Larsen	Chairman	Rådet for Bæredygtig trafik
Nuhu	Sulemana	Student	University of Copenhagen
Finn	Danielsen	Cand. Scient.	NORDECO
Zeljka	Fistrek	Master's student	Lund University Centre for Sustainability Studies
Lorenzo	Martini	Second Secretary	Embassy of the United States to Denmark
Tesfom	Solomon	Postgraduate student	Lund University
Nina	Srot	Student	Lund University
Tim	Taylor	Student	Lund University
Elsebeth	Tarp	Senior Advisor	Ministry of Foreign Affairs of Denmark
Rolf	Hernø	Programme Coordinator	CARE Danmark
Dominic Taku	Tassa	Student	University of Copenhagen
Abbas	Salum	Project Assistant	UNEP Risø Centre (URC)
Marie	Sigvardt	Student	Roskilde University (RUC)
Bjørn	Gunnarsson	Student	Lund University
Liv	Oestergaard	Master's student	Lund University
Jørgen	Svendsen	MSc Engineering	Bolbrodalen 2, 2960 Rungsted Kyst
Sven	Hindkjær	Consultant	NIRAS
Albert	Wright	Chief Adviser	Ministry of Foreign Affairs of Denmark
Anna	Mogensen	Journalist	Udvikling
Christian Pilegaard	Hansen	International Co-ordinator	Danish Centre for Forest, Landscape and Planning
Morten	Pedersen	Business Development Manager Climate Change	MIRAS
Helene	Bjerre Jordans	Partner	PEMconsult A/S
Reshmi	Vasudevan	Researcher/Student	Lund University (LUCSUS)
Pernille	Nøddekær	Consultant	Energy Consulting Network
Thorkil	Casse	Associate Professor	Roskilde University
Rikke	Roerup	Assistant Coordinator	Danish 92 Group
Kasper	Agger	Research Assistant	UNEP
Roger	C. Moreno	Chargé d'Affaires a.i.	Embassy of Venezuela
Barbara	Verlic Christensen	PhD, researcher	University of Copenhagen, Dept. of Geography and Geology

continues

Firstname	Surname	Title	Organisation
Maj	Manczak	Programme Coordinator miombo	WWF Danmark
Finn	Tobiesen	Head of OVE International	Organisation for Sustainable Energy
Silke	Mason Westphal	Ph.D., Technical Advisor	TAS, MFA
Morten	Fauerby Thomsen	Programme Coordinator	CARE Danmark
Sten	Dieden	Researcher	UNEP Risoe Center
Christine Rud	Wennerberg	Energy Planner	Energica
Lillah	Emmik Sørensen	Consultant	COWI
Michael	Kvetny	Consultant	COWI
Niels Bisgaard	Pedersen	Senior Energy Consultant	COWI
Troels	Dam Christensen	Coordinator	Danish 92 Group
Faouzi	Senhaji	Scientist	Risø
Karl	Allesø	Engineer	Independent Consultant
Benét	Hermind	Civil Servant	Danish Energy Agency
Jakob	Kronik	Independent Consultant	F7 Consult
Søren	Moestrup	Special Consultant	University of Copenhagen
Peter	Iversen	Assistant Forester	Danish Ministry of Climate and Energy
Mariana	González Armijo	Master's Student	Lund University
Mette Annelie	Rasmussen	Project manager	UNEP Risø Centre, Risø - DTU
Charlotte	Mathiassen	Anthropologist	PEM Consult
Mike	Speirs	Adviser	TAS, Ministry of Foreign Affairs of Denmark
Janne	Lykke Facius	Programme intern	CARE Dk
Helle Munk	Ravnborg	Senior researcher	DIIS
Jakob	Skovgard	Head of Section	Danish Ministry of Finance
Søren	Hvalkof	Senior Project Researcher	DIIS
Sine	Skov	Consultant	NIRAS A/S
Helene	Gjerding	Programme Coordinator	IBIS
John	Agami	Chairman	Lado political Council
Malene	Wiinblad	Consultant	PEM Consult
Said	Abdallah	Researcher	UNEP Risoe Centre, Danish Technical University
Ebbe	Schiøler		
Ivan	Shilov	Third secretary	Russian Embassy
Jacob Ipsen	Hansen	Student	Roskilde University
Uffe	Æ. Christiansen	Student	Roskilde University
Peter W.	Bentzen	Student	Roskilde University
Bo	Gregersen		
Alessandro	Barni	Student	Lund University

Annex I
Selected institutions, networks and resource websites on low carbon development

The following list shows selected institutions and resource websites working on low carbon development. It should be noted that the list is indicative only, and that it focuses on institutions and resource websites drawn upon by this study.

Institutions and networks, Energy

Name	Focus	Selected contact(s)	Web
UNEP/Risø	Capacity building/ research on sustainable energy in developing countries	Gordon Mackenzie	http://www.uneprisoe.org/energy.htm
Tyndall Centre for Climate Change Research	General climate change (incl. adaptation). On mitigation, esp. prominent on energy	UK research institutions. Headed by Director: Kevin Anderson Human development: Katrina Brown	http://www.tyndall.ac.uk/
Worldwatch Institute	Research and information on climate change and energy	-	http://www.worldwatch.org/programs/energy_climate
Energy Information Administration	Official energy statistics from the US government	-	http://www.eia.doe.gov/
World Council for Renewable Energy	Information and documentation on renewable energy	-	http://www.wcre.de/en/index.php?option=com_frontpage&Itemid=1
KITE	Capacity building and research on renewable energy in West Africa	Harriette Ammisah-Arthur	http://kiteonline.net/
AFREPREN	Energy, Environment and Development Network for Africa	-	http://www.afrepren.org/
African Rural Energy Enterprise Development	UNEP initiative to promote rural energy entrepreneurs	-	http://www.areed.org/program/index_program.htm
Organisation for Sustainable Energy	Alternative energies	Finn Tobiesen	http://www.ove.org
Nordisk Folkecenter	Information on renewable energy solutions	Preben Maegaard	http://www.folkecenter.net/
Mali Folkecenter	Grassroots initiatives on renewable energy	Ibrahim Togola	http://www.malifolkecenter.org/

continues

Institutions and networks, Agriculture

Name	Focus	Selected contact(s)	Web
ICROFS	Climate and organic farming	Niels Halberg m.fl.	http://www.icrofs.org/
Consultative Group on International Agricultural Research (CGIAR)	Land-use management for pro-poor mitigation		http://www.cgiar.org/impact/global/cc_managingtropicallands.html
Center for Information on Low External Input and Sustainable Agriculture (LEISA)	Sustainable small-scale farming		http://www.ileia.org/
LIFE, University of Copenhagen	A wide range of research and researchers with natural science expertise of relevance to adaption and mitigation activities globally, and LDCs in particular	John R. Porter	http://spoergomklima.ku.dk/forskere/
Faculty of Agric. Sciences, Aarhus University		Jørgen E. Olesen,	http://www.agrsci.dk/
Institute of Food and Resource Economics, University of Copenhagen		Søren E. Frandsen.	www.foi.life.dk
Danish National Environmental Research Institute (DMU)		Henning Høgh Jensen	http://www.dmu.dk/Udgivelser/DMUNyt/2008/20/hhj.htm
Økologisk Landsforening (Denmark)	Organic farming	Henrik Platz	http://www.okologi.dk/Om_%C3%98kologisk_Landsforening/

Institutions and networks, Forests/REDD

Name	Focus	Selected contact(s)	Web
Woods Hole Research Center	REDD readiness (esp. Brazil, DRC)	Daniel Nepstad	http://www.whrc.org/
Kyoto: Think Global Act Local Programme	Capacity-building/ research on community REDD in Asia, Africa and Latin America	Margareth Skutsch	http://www.communitycarbonforestry.org/
Center for International Forestry Research (CIFOR)	Multiple aspects of REDD policies and economics	Arild Angelsen Sven Wunder	http://www.cifor.cgiar.org/
International Union for the Conservation of Nature (IUCN)	Poverty and national policy development for REDD	Stewart Maginnis	http://www.iucn.org/what/ecosystems/forests/
ODI Climate Change, Environment and Forests Programme	REDD and poverty	David Brown Leo Peskett Jessica Brown	http://www.odi.org.uk/ccef/index.html
International Institute for Environment & Development (IIED)	Poverty and biodiversity aspects of REDD – links to adaptation	Virgilio Viana Camilla Toulmin	http://www.iied.org/climate-change/
Collaborative Modelling Initiative on REDD Economics	Economic modeling of REDD options and impacts	Research collaboration. Lead: Jonah Busch, Conservation International	http://www.conservation.org/osiris/Pages/overview.aspx
Rights and Resources Initiative	Forest tenure and rights	Coalition of partners, incl. leading international research organisations and NGOs, as well as Indigenous Peoples and community forestry networks.	http://www.rightsandresources.org/
Global Canopy Program	Overviews of REDD policies and proposals ("Little REDD Book" etc.)	Network of research institutions in 19 countries	http://www.globalcanopy.org/
Forum On Readiness in REDD	REDD readiness	Forum for countries, donors and international organisations involved in REDD (incl. FCPF and UNREDD)	http://www.whrc.org/policy/REDD/

continues

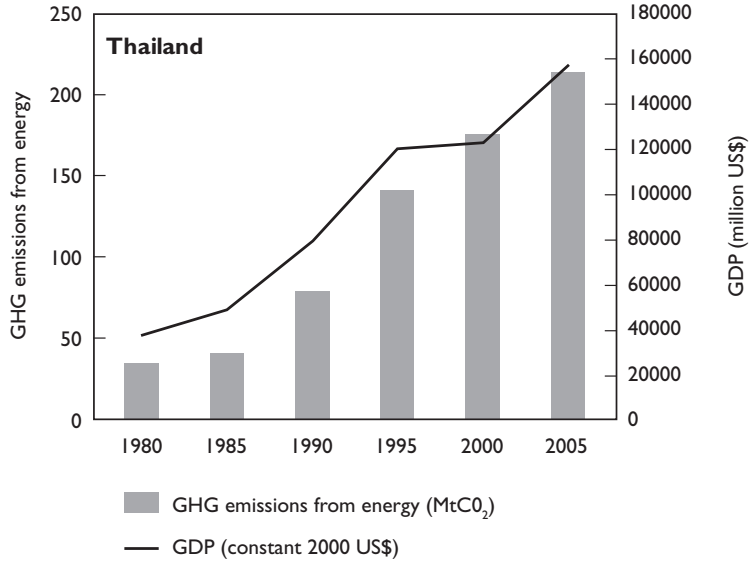
Name	Focus	Selected contact(s)	Web
Katoomba Group	PES aspects of REDD	International group of individuals. President: Michael Jenkins	http://www.katoombagroup.org/
Danish Centre for Forest, Landscape and Planning	Forest management, policy and rights	Christian Pilegaard Iben Nathan	http://www.sl.life.ku.dk/
Monitoring Matters Network	Participatory forest monitoring	International network on participatory monitoring	http://www.monitoringmatters.org/
International Work Group for Indigenous Affairs (IWGIA)	REDD and indigenous rights	Sille Stidsen	http://www.iwgia.org/

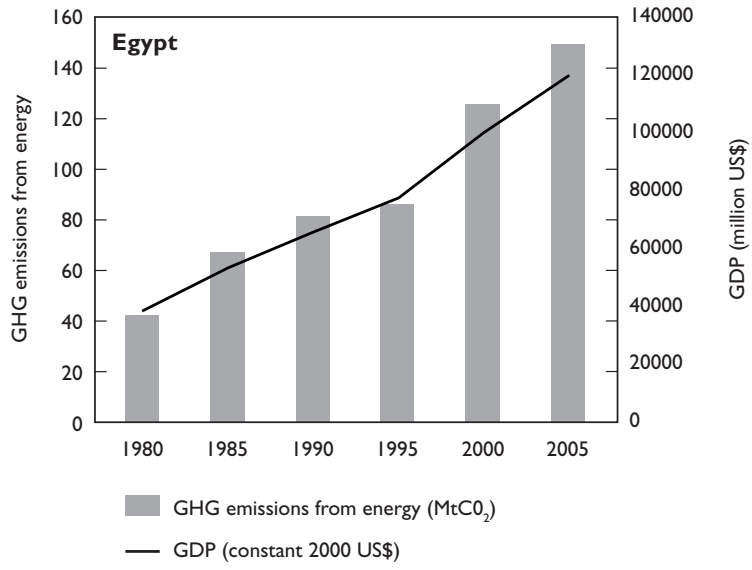
Resource websites

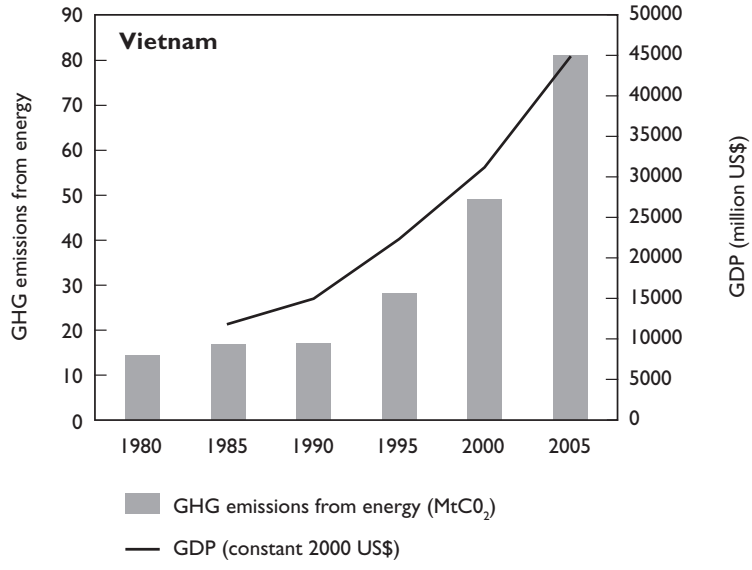
Name	Focus	Web
UNFCC	Information on international protocol on climate change	http://unfccc.int/2860.php/
Climate Funds Update	Overviews and news of climate funding	http://www.climatefundsupdate.org/
Climate Analysis Indicators Tool	Databases on climate change	http://cait.wri.org/
Capacity development for CDM	Database on CDM projects	http://cd4cdm.org/
REDD Monitor	Information and news site about REDD	http://www.redd-monitor.org/
REDD M&V Roadmap	Overview of global needs and efforts for REDD monitoring and verification	http://redd.wetpaint.com/
UNFCCC REDD Platform	REDD information sharing platform	http://unfccc.int/methods_science/redd/items/4531.php

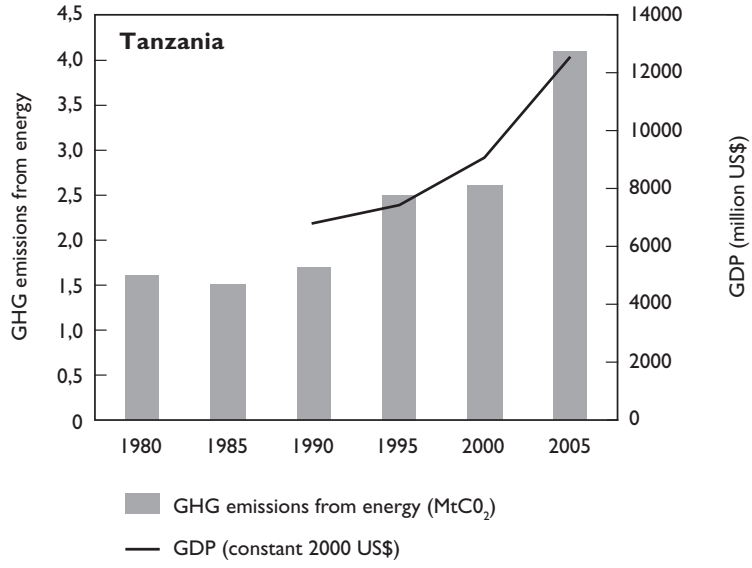
Annex J
Emissions and GDP growth in selected countries

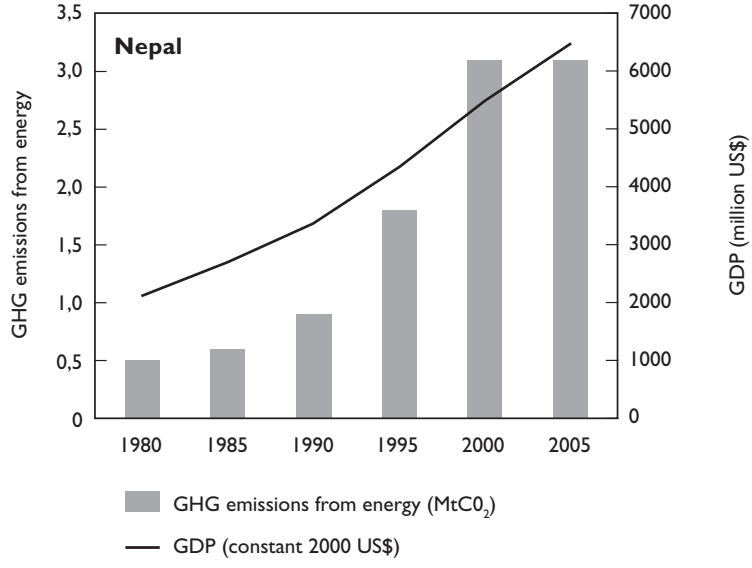
The following shows GHG emissions and GDP growth for six Danida collaboration countries with varying GDPs. Data sourced from WRI Climate Analysis Indicators Tool: http://cait.wri.org/

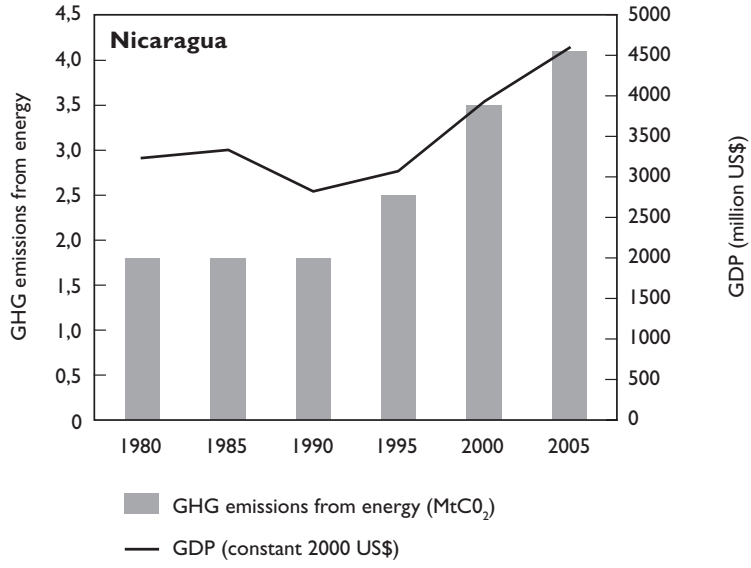



Egypt
GHG emissions from energy
GDP (million US$)
160
140
120
100
80
60
40
20
0
140000
120000
100000
80000
60000
40000
20000
0
1980
1985
1990
1995
2000
2005
GHG emissions from energy (MtC0$_2$)
GDP (constant 2000 US$)


Vietnam
GHG emissions from energy
GDP (million US$)
90
80
70
60
50
40
30
20
10
0
50000
45000
40000
35000
30000
25000
20000
15000
10000
5000
0
1980
1985
1990
1995
2000
2005
GHG emissions from energy (MtC0$_2$)
GDP (constant 2000 US$)


Tanzania
GHG emissions from energy
GDP (million US$)
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0
14000
12000
10000
8000
6000
4000
2000
0
1980
1985
1990
1995
2000
2005
GHG emissions from energy (MtC0$_2$)
GDP (constant 2000 US$)


Nepal
GHG emissions from energy
GDP (million US$)
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0
7000
6000
5000
4000
3000
2000
1000
0
1980
1985
1990
1995
2000
2005
GHG emissions from energy (MtC0$_2$)
GDP (constant 2000 US$)


Nicaragua
GHG emissions from energy
GDP (million US$)
4,5
4,0
3,5
3,0
2,5
2,0
1,5
1,0
0,5
0
5000
4500
4000
3500
3000
2500
2000
1500
1000
500
0
1980
1985
1990
1995
2000
2005
GHG emissions from energy (MtC0$_2$)
GDP (constant 2000 US$)