

The Impact of Climate Change, Desertification and Land Degradation on the Development Prospects of Landlocked Developing Countries



UN-OHRLS

United Nations Office of the High Representative for the
Least Developed Countries, Landlocked Developing Countries
and Small Island Developing States (UN-OHRLS)



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ADB	Asian Development Bank	DLDD	Desertification, land degradation and drought
AfDB	African Development Bank	EAC	East African Community
AMCOW	African Ministers' Council on Water	ECA	Economic Commission for Africa
AMU	Arab Magreb Union	ECOWAS	Economic Community of West African States
APoA	Almaty Programme of Action	EEP	Energy and Environment Partnership
AU	African Union	EI	Environment Initiative
AWF	African Water Facility	ENSO	El Nino Southern Oscillation
CAADP	Comprehensive Africa Agriculture Development Program	EU	European Union
CAF	Cancun Adaptation Framework	FAO	Food and Agricultural Organization
CBD	Convention on Biological Diversity	FDI	Foreign Direct Investment
CCAP	Climate Change Action Plan	FINIDA	Finnish International Development Agency
CEIF	Clean Energy Investment Framework	FIP	Forest Investment Program
CIDA	Canadian International Development Agency	FHHs	Female Headed Households
CIFOR	Center for International Forestry Research	GCCA	Global Climate Change Alliance
CILSS	Permanent Inter-State Committee on Drought Control in the Sahel	GDP	Gross Domestic Product
CRGE	Climate Resilient Green Economy	GEF	Global Environment Facility
CRMA	Climate Risk Management and Adaptation	GLADA	Global Land Degradation Assessment
COP	Conference of Parties	GM	Global Mechanism
DANIDA	Danish International Development Agency	GTZ	German Technical Cooperation Agency
DFID	Department for International Development (UK)	HIPC	Heavily Indebted Poor Country

IFES	Integrated Food Energy Systems	RAP	Regional Action Program
IGAD	Intergovernmental Authority on Development	RCU	Regional Coordination Unit
IPCC	Intergovernmental Panel on Climate Change	REC	Regional Economic Community
IRENA	International Renewable Energy Agency	SADC	Southern African Development Community
IWRM	Integrated Water Resource Management	SLM	Sustainable Land Management
JICA	Japan International Cooperation Agency	SRAP	Sub-Regional Action Program
LADA	Land Degradation Assessment	SREP	Scaling Renewable Energy for low income Countries
LDCF	Least Developing Countries Fund	SSA	Sub-Saharan Africa
LLDCs	Landlocked Developing Countries	TroFCCA	Tropical Forest and Climate Change Adaptation
MDB	Multilateral Development Bank	UN	United Nations
MDGs	Millennium Development Goals	UN-OHRLLS	United Nations Office of the High Representative for the Least Developed Countries, Landlocked Developing Countries, and Small Island Developing States
NAPA	National Adaptation Program of Action	UNCCD	United Nations Convention to Combat Desertification
NAPs	National Action Programs	UNCTAD	United Nations Conference on Trade and Development
NCBs	National Coordinating Bodies	USAID	United States Agency for International Development
NCCSP	Nepal Climate Change Support Program	WHO	World Health Organization
NDFs	National Desertification Funds	WMO	World Meteorological Organization
NORAD	Norwegian Agency for Development Cooperation		
OSS	Sahara and Sahel Observatory		
PPCR	Pilot Program for Climate Resilience		

Landlocked developing countries (LLDCs) are disadvantaged in a myriad of ways and they have special needs which require special attention. Challenges such as undiversified economies, vulnerability to climate change and climate variability, land degradation and desertification, among others, are undermining the economic potential of many LLDCs. This has been exacerbated by weak export base of many LLDCs centered on a few primary agricultural and/or mineral commodities. Further, because of their physical location markedly characterized by lack of access to sea ports, LLDCs are popularly referred to as “prisoners of geography”. This leaves most LLDCs at a distinct disadvantage as they cannot compete in international trade markets. Added together, this has created a situation in which LLDCs are among the poorest of the poor. In order to address this specific challenge, the United Nations First International Ministerial Conference of Landlocked and Transit Developing Countries and Development Partners held in Almaty, Kazakhstan, in 2003, adopted the Almaty Programme of Action (APoA) whose central thrust was to: Address the Special Needs of Landlocked Developing Countries within a New Global Framework for Transit Transport Cooperation for Landlocked and Transit Developing Countries.

This comprehensive global partnership programme was intended to address essential transit transport problems and facilitate trade for LLDCs. Under the resolution 66/214 of the United Nations General Assembly, a ten-year review of the Almaty Programme of Action was undertaken in November 2014 to take stock on the performance of LLDCs over the past decade and adopted the Vienna Programme of Action (VPoA). One lesson learnt during the implementation of the APoA is that gains and momentum made by the LLDCs can be subdued unless threats posed by climate change, land degradation and desertification are seriously addressed. This study, therefore, seeks to draw the attention of the international community, policy makers and development agencies to the severe impact that climate change, desertification and land degradation has on the economies of LLDCs. Despite their huge negative impact on LLDCs, these issues have not received the international attention and priority they deserve.

This study seeks to identify LLDCs’ priority areas on climate change, land degradation and desertification that could be included in their new development agenda. In order to achieve this objective, the study: (a) provides a comprehensive review of the impact of climate change, desertification and land degradation on LLDCs, (b) reviews national, regional and international interventions which have been implemented in LLDCs; (c) identifies best practices, lessons learnt and emerging opportunities and (d) proffers recommendations for inclusion in a new development agenda for LLDCs which will assist them to ameliorate the negative impacts of climate change, desertification and land degradation.

Recommendations on priorities of LLDCs on climate change, desertification, land degradation and drought

What has emerged from this study is that there is an imperative need to give LLDCs special attention in as far as the issues of climate change, land degradation and desertification are concerned. Although these issues have generally attracted considerable attention of the global community, there is no special focus on LLDCs, yet these countries are among the worst affected. Based on this review, a number of lessons, priorities and recommendations are drawn which can help shape further policy debates and concrete future plans of action. It is important to build the resilience of LLDCs to withstand the impact; build their adaptive capacity; and mitigation capacity.

Priority 1: Strengthen National Programs

Strengthening of the development strategies and implementation of National Action Plans to fight desertification and National Adaptation Plans

Several LLDCs have developed and are implementing National Adaptation Plans for climate change and National Action Plans to fight desertification and manage natural resources. However, it is clear that considerable effort is required along with added capacity building and technology transfer in order to be successful in meeting the needs to develop and implement the plans. Greater emphasis ought to be placed on developing the plans in a holistic way and incorporating climate change and desertification into development priorities at the national and regional levels. Making close linkages between the United Nations Convention for Combating Desertification (UNCCD) National Action Plans with the UNFCCC National Adaptation Plans could boost synergies and prove cost effective. Additional resources are required from the international community that are specifically earmarked to address climate change and desertification issues and to enable LLDCs to effectively implement the National Adaptation Plans and National Action Plans.

Priority 2: Agriculture and Food Security

Agriculture, livelihood sustenance and food security remain top priority in LLDCs

Agriculture remains the linchpin of the economies of many LLDCs offering the most feasible strategy to promote economic development of these countries. Further, agricultural development and advancement also offers the desired pathway to poverty reduction and food insecurity improvement – two vices which remain unacceptably high in LLDCs. However, agriculture is one of the sectors worst affected by climate change, land degradation and desertification. Unless these challenges are seriously addressed, achieving the full potential of the agricultural sector in LLDCs could prove difficult.

Encourage investment in climate-smart agriculture in LLDCs

Climate-smart agriculture is one new approach that is increasingly gaining recognition as an innovative approach to addressing challenges of climate change, land degradation and food security. It calls for enhanced agricultural productivity and sustainable land-use management through minimal water depletion and soil-disturbing cultivation practices. It is recommended that the UN leads international efforts in promoting adoption of climate-smart agriculture amongst LLDCs with a well-defined plan of action.

Strive to diversify the economic base of LLDCs

Most LLDCs are characterized by over-dependence on the production of a single or a few primary commodities of either agricultural or mineral in nature. This leaves many of them highly vulnerable to natural shocks, particularly climate change-related risks. There is a need to assist LLDCs build diversified economies that are resilient to economic shocks and that are capable to produce a range of value-added goods that are competitive on the world market. Impact of climate change, desertification and land degradation can be reduced by encouraging households to adopt live-lihood systems that are less dependent on traditional land uses and less demanding on local land and natural resource use, yet can provide sustainable income. The international community should play a decisive role in assisting the LLDCs to build diversified economies.

Priority 3: Water Security

Because most LLDCs are located in dryland areas, water imposes the most severe constraint

LLDCs are the most water stressed countries by virtue of their geographical location. Many LLDCs are located in dry regions where hyper-arid, semi-arid and arid conditions prevail. These conditions are set to worsen due to climate change, desertification and land degradation. As observed in the study, more than 15 per cent of drylands worldwide are located in LLDCs. Furthermore, 60 per cent of the population in LLDCs are located in these drylands compared to only 32.2 per cent in transit countries. This underlies severe implications on water security. Water scarcity is set to impose severe constraints on developmental aspirations of LLDCs. More international assistance and priority is needed to help LLDCs invest in water infrastructure and water resource development.

Priority 4: Energy Security

Promote sustainable energy with a focus on renewable energy

Energy plays a pivotal role in the future development of LLDCs. Not only do LLDCs have the highest proportion of poor households, they also have the highest proportion of households that directly depend on traditional biomass to meet their energy requirements. This has exerted immense pressure on forest resources leading to extensive deforestation, further land degradation and desertification. The international community needs to help LLDCs ensure that millions of people have access to modern energy services which are affordable, efficient, sustainable and renewable. This is one approach not only crucially important for tackling climate change, land degradation and desertification but also addressing the issue of poverty.

Priority 5: Disaster Risk Reduction and Early Warning Systems

Establish 'global catastrophic climate change disaster insurance facility' fund for LLDCs

There tends to be a fragmented approach to protecting LLDCs against extreme catastrophic events. In addition there is no single well-coordinated fund that is dedicated to supporting such efforts. Extreme events associated with climate change (e.g. floods, droughts) can cause massive destruction that can overwhelm LLDCs, especially the poorest subset. A model example can be taken from the Caribbean countries which established a common "disaster risk management fund" as a regional collective response to the challenges posed by extreme climate events (typhoons, hurricanes, tsunamis, etc). It is, therefore, recommended that the international community help pool such a special climate disaster risk insurance fund that targets LLDCs as they are among the most vulnerable countries to extreme climate events.

Strengthen early warning systems

Using remote sensing and satellite technology can boost early warning systems in LLDCs. They are capable of providing rapid and effective detection of hazards such as wildfires, deforestation, drought, floods, changes in water levels, and natural hazards. It is critical that national and regional early warning systems be strengthened across LLDCs. It is recommended that national and regional early warning systems must receive high priority as climate change mitigation tools.

Priority 6: Information Systems and Research

Raise public awareness and access to information

LLDCs are among countries with the least climate change, land degradation and desertification awareness. A low level of awareness undermines the country's capacity to adapt and mitigate these factors. Public access to information encourages mass participation in national mitigation and adaptation strategies. It is therefore essential for LLDCs to establish awareness programmes which target specific stakeholders.

Establish strong research links

There is limited known empirical evidence regarding effects of climate change on LLDCs. Research plays an important role in informing LLDCs on the degree and scope of the effects of climate change, land degradation and desertification on their economies and the livelihoods of their populations. Research institutions can be helpful in identifying the special needs, priorities and interests of LLDCs within the context of their national circumstances. For instance, the development of indices for monitoring and evaluation of desertification and land degradation processes within LLDCs could be conducted via academic research centres.

Priority 7: Capacity Building

Institutional and human capacity building

Generally, LLDCs have low human and institutional capacity to deal with the causes and effects of climate change, desertification and land degradation. LLDCs are characterized by weak capacities, institutions and adaptation and mitigation policies and practices. There is a need for LLDCs to strengthen their institutional capabilities in order to be able to identify best initiatives to combat climate change, desertification and land degradation to suit their circumstances, priorities and interests.

Why Landlocked Developing Countries Deserve Special Attention?

1.1 Background

Landlocked developing countries (LLDCs) are faced with a myriad of challenges linked to their geography which grossly undermine their overall economic development. This in turn has undermined their capacity to achieve the Millennium Development Goals. By definition, LLDCs are countries whose territorial boundaries lie inland with no outlet to the sea. Any physical outlet to the sea has to be “negotiated” with neighbouring coastal countries. There are 32 LLDCs whose distribution is shown in Table 1.

Table 1. LLDCs and their regional location

Sub-Saharan Africa	Botswana Central Africa Republic Lesotho Niger Uganda South Sudan	Burkina Faso Chad Malawi Rwanda Zambia	Burundi Ethiopia Mali Swaziland Zimbabwe
Asia	Afghanistan Bhutan Lao Peoples' Democratic Republic Tajikistan	Kazakhstan Mongolia Turkmenistan	Kyrgyzstan Nepal Uzbekistan
Europe	Armenia Macedonia	Azerbaijan Moldova	
Latin America	Bolivia	Paraguay	

LLDCs, despite being located in four different continents, share common handicaps which include, *inter alia*, geographical remoteness; dependence on transport systems in neighbouring and coastal countries, diminished competitiveness on international markets and predominantly natural resource-based economies with a limited export base. The sea is the linchpin of international commerce and trade. Compared to maritime states, LLDCs always incur extortionate transport costs in the process of international trade because of their distance from seaports.

Moving goods between capital cities of LLDCs and the nearest seaport is a daunting task as the distance can stretch thousands of kilometres (as shown in Table 2). For instance, Central Asian countries face the longest distance (more than 4,000km) from the nearest port. Worse still, some countries like Uzbekistan or Burundi, are doubly landlocked meaning they have to transit at least two countries before reaching the seaport. Other countries like Bhutan and Nepal face mountainous terrain of the Himalayas which prohibits them from using shorter (via China) routes to the sea. The problem is further compounded by the poor state of roads as many LLDCs and transit countries only have a small proportion of their roads paved. While most of the roads in Europe and Central Asia are paved, this sharply contrasts the situation in Africa, particularly the Sahel region, where less than 10 percent of the roads are paved. In other unfortunate cases, civil conflicts/wars in transit countries often force the affected LLDC to use longer and less safe routes to the seaport, thus pushing transport costs and transit risks beyond proportion.

Henderson *et al* (2000:10) estimates that high transport costs can decrease a country's trade volume by about 80 percent. Because of high transport cost, most LLDCs are at a distinct disadvantage as they face expensive imports. This in turn pushes high the local prices of goods and services, rendering most commodities too expensive for a majority of poor households to afford. On the export front, high transport costs reduce competitiveness of exported goods on the international markets. Hence the prohibitive geography of LLDCs constitutes an inherent trade barrier whose adverse effects on international trade are worse than those caused by tariffs and other forms of trade barriers.

Table 2. Average distances from the sea and percent of paved roads in LLDCs by sub-regions

Sub-region LLDCs	Average percent of paved roads	Average distance from the sea (km)
Southern Africa	32.2	819
East Africa	9.0	1,272
Sahel	7.9	1,983
Latin America	28.7	718
Europe	75.1	170
East Asia	26.3	1,062
Central Asia	79.1	2,328

Source: UNCTAD, 2006

LLDCs are disadvantageded not only by their distance from the sea but also by other international trade challenges which they have no control over. They are only able to trade less when compared to transit/coastal countries. Their access to international overseas markets is based on the goodwill of the transit country as well as the prevailing political stability and peacefulness of the neighbouring transit countries. Faye et al (2004) discuss four types of dependence which include: neighbour's infrastructure, sound cross-border political relations, peace and stability and administrative practices. In situations where these factors are compromised, these can cause severe harm to the economic prospects of the affected LLDC. Chowdhury and Erdenebileg (2006) maintain that the challenges encountered by LLDCs manifest themselves in the following:

- regardless of whether a LLDC possesses world class infrastructure, it's economic growth and trade potential will be hamstrung if the transit country has not invested sufficiently in its infrastructure,
- LLDCs often find themselves subject to border blockages or other impediments to trade should they be in conflict with their transit neighbours;
- When transit neighbours suffer from strikes, natural disasters, civil or economic upheavals, the transit routes used by LLDCs may become, unsafe, damaged or even closed; and
- Passing through the territory of transit neighbours invariably results in significant administrative burdens on LLDC traders.

1.2 Brief overview of Almaty Programme of Action and of the economies of LLDCs

In view of these challenges, the Almaty Ministerial Conference (held in Kazakhstan, 2003) was the first to make a global call that formally recognized the need to address the unique problems affecting the LLDCs. It brought together landlocked and transit developing countries, donor countries, and international financial and development institutions and crafted a plan of action – Almaty Programme of Action (APoA). Central to the APoA's mission was to address five priority areas which include addressing (a) fundamental transit policy issues; (b) infrastructure development and maintenance; (c) international trade and trade facilitation; (d) international support measures; and (e) implementation and review.

The programme of action intended to achieve the following objectives:

- Secure access to and from the sea by all means of transport according to applicable rules of international law
- Reduce costs and improve services so as to increase the competitiveness of their exports

- Address problems of delays and uncertainties in trade routes
- Develop adequate national networks
- Reduce loss, damage and deterioration *en route*
- Open the way for export expansion
- Improve safety of road transport and security of people along the corridors

Overall the LLDCs made some improvements in their economic growth under the APoA. According to the 2013 *Report of the Secretary General on the Implementation of the APoA*, international financial support to the LLDCs increased substantially since 2003. Flows of official development assistance from traditional donors increased substantially from US\$ 11.1 billion in 2000 to US\$ 24.3 billion in 2011 and Aid for Trade disbursements to LLDCs rose from US\$ 4.7 billion in 2006 to US\$ 6 billion in 2010. Foreign Direct Investment net inflows to LLDCs increased from US\$ 3.9 billion in 2000 to US\$ 35.0 billion in 2011.

Although LLDCs' share of world trade remains small, at a little under 1.2 percent in 2013 it has nonetheless increased from the 2001 share of just over 0.5 percent. Comparatively, the transit countries have a much higher share at about 6 percent. A major lesson learnt from the implementation of the APoA is that climate change, land degradation, and desertification are important issues that affect the development prospects of the LLDCs. This call emanates from the severe impact that climate change, land degradation and desertification are inflicting on the development imperatives of LLDCs. The international community is becoming increasingly concerned with the impacts of these factors on the development prospects of LLDCs. Many studies indicate that the collective impact of these factors is projected to have more disproportionate effects on the economies of LLDCs for a number of reasons:

- LLDCs are largely characterized by limited productive capacity and non-diversified economies – typically concentrated on one or few bulky primary agricultural and mining commodities – making them highly vulnerable to climate change and climate variability and other external shocks.
- Climate change, desertification and land degradation pose potentially permanent and serious threats to the economic and social development of LLDCs as they are the most vulnerable and least prepared to confront these challenges (as discussed later).
- LLDCs contain a subset of the poorest and geographically disadvantaged countries in the world, and countries whose plight is worsened by lack of human, institutional, capital and financial resource depth to deal effectively with the challenges posed by climate change, desertification and land degradation.
- The global food price hikes tied to bio-fuels and persistent rise in international oil prices are “newly emerging challenges” which threaten to derail the limited progress achieved by most LLDCs. Given many LLDCs are net importers of major cereal crops (wheat, rice, maize), food price hikes translate into severe shocks that will hurt the economies of LLDCs to the core in both short and long run.

Today, most of the LLDCs are among the most disadvantaged and impoverished countries in the entire world. It is not by coincidence that their economies continue to perform so poorly. Deep-seated constraints and challenges linked to landlockedness constitute major impediments. Unless these misfortunes are adequately addressed, economic performance of most LLDCs will continue to lag behind that of non-landlocked developing countries.

1.3 Objectives of the study

This study seeks to draw attention of the international community, policy makers and development agencies to the severe damages that climate change, desertification and land degradation are inflicting on the economies of LLDCs. Despite their huge negative impacts, these issues have not received the international attention they deserve.

This study seeks to identify priority areas on climate change, land degradation and desertification for a new development agenda for LLDCs. In order to achieve this objective, the study will:

- Provide a comprehensive review of the impact of climate change, desertification and land degradation on LLDCs;
- Investigate national, regional and international interventions which have been implemented in LLDCs;
- Identify best practices, lessons learnt and opportunities for landlocked developing countries; and
- Proffer recommendations for a new development agenda for LLDCs which will assist them to ameliorate the deleterious impacts of climate change, desertification and land degradation.

The remainder of the report is structured as follows: section 2 provides a comprehensive discussion of the impacts of climate change, desertification and land degradation on the economies of LLDCs; section 3 discusses the policy interventions implemented at national, regional and international level including a critical analysis of the strengths and short-comings; section 4 presents the lessons learnt, policy gaps and emerging opportunities; section 5 discusses the way forward including priorities, recommendations and conclusions.

2.0 Introduction

This section presents a comprehensive review of the impacts of climate change, desertification and land degradation on the economies of LLDCs. Climate change-desertification-and land degradation nexus involves physical processes that feed into and influence each other in a complex way not yet well understood and established by scientific researchers. The aim here is not to delve into the complex interrelationships amongst these factors but rather to explore how each factor negatively impacts the economies of LLDCs.

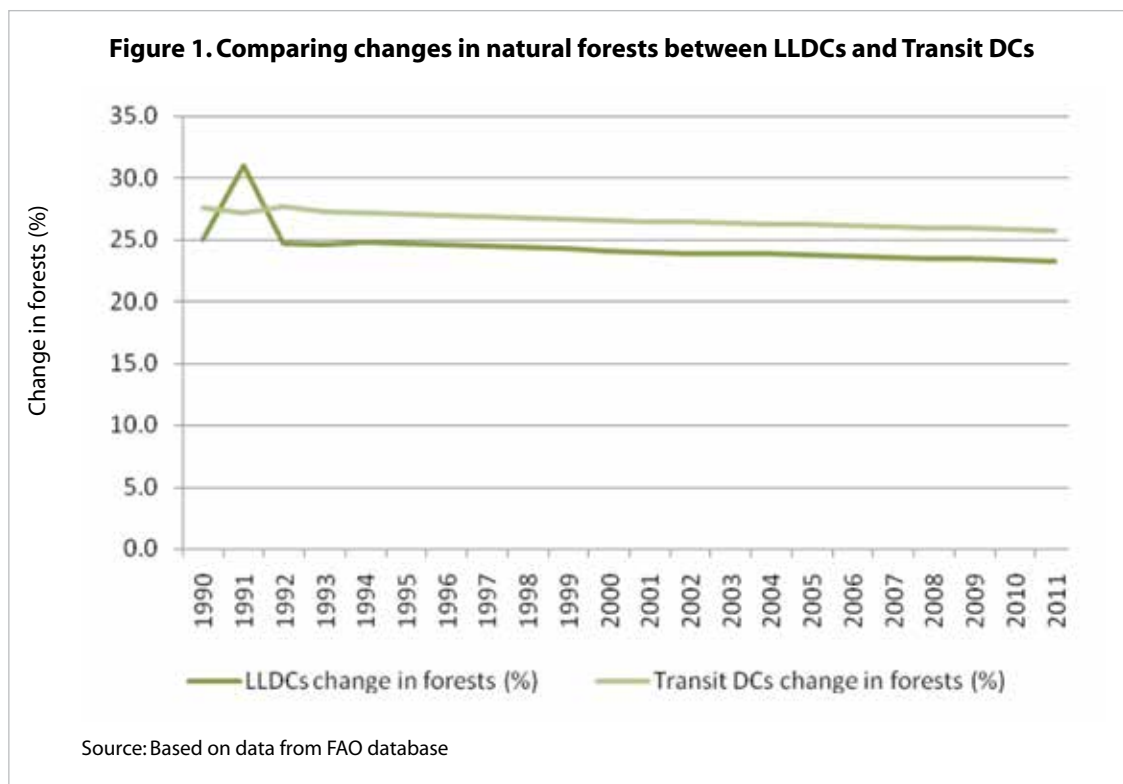
UNFCCC (2008) defines climate change as “change of climate that is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and that is in addition to natural climate variability observed over comparable time periods”. The main features of climate change are increases in global temperature (global warming) as a result of increased accumulation of greenhouse gases in the atmosphere; changes in intensity, frequency and distribution of precipitation across space and time; melting of ice caps and glaciers and reduced snow cover; and increases in ocean temperatures and ocean acidity – due to seawater absorbing heat and carbon dioxide from the atmosphere. As a result of global warming, incidences of extreme events such as tropical cyclones, floods, droughts and heavy precipitation, are expected to rise even with moderate temperature increases. Changes in some types of extreme events have already been observed, for example, increases in the frequency and intensity of heat waves and heavy precipitation events. For instance an increasing rate of warming has been observed over the past 25 years, and 11 of the 12 warmest years on record have occurred in the past 12 years. The IPCC projections indicate that global warming will continue to accelerate during the 21st century.

Desertification is “land degradation in arid, semi-arid and dry sub-humid lands”, while land degradation is the “persistent reduction of biological and economic productivity” (IFAD 2010). Because of its severe impact on human well-being and the environment, “desertification ranks among the greatest development challenges of our time” (GIZ ((Deutsche Gesellschaft für Internationale Zusammenarbeit), 2013). Desertification is largely driven by a core of direct and indirect factors mostly attributed to climatic variability and unsustainable human activities.

Direct anthropogenic factors such as overgrazing, over-cultivation, inappropriate land use and deforestation are the major causes and/or drivers of land degradation and desertification. Factors such as poverty associated with total dependency on natural resources by the poor are some of the indirect causes driving land degradation and desertification across many LLDCs. The term “environmental refugees” is often coined to refer to people migrating to “safer regions” – an influx usually triggered by the occurrence of extreme events such as extreme droughts, floods, cyclones, tornadoes, landslides, etc.

Deforestation, especially to meet energy needs, is a direct cause of desertification in LLDCs. ECA (2007) reports that in Africa more than 15 million hectares of tropical forests are depleted or burnt every year in order to provide for small-scale agriculture or for use as fuel energy for heating and cooking purposes. Deforestation is undesirable as it leads to a loss of fertility through soil erosion and runoff. The soils become shallow and of low fertility and the water-holding capacity of the soil diminishes.

Figure 2 compares changes in natural forests occurring in LLDCs versus Transit developing countries (Transit DCs) due to deforestation for the period 1990 to 2011. From 1990 to 2011 natural forests in LLDCs dropped by 7% compared to only 2% in Transit DCs. Assuming a “business-as-usual” approach projections show that by 2020 natural forests could decline by 15 - 20% in LLDCs – implying severe land degradation and desertification problems in LLDCs.



To facilitate discussion, the section below is divided into two parts: the first part discusses the vulnerability of LLDCs to climate change, desertification and land degradation and the second part discusses the impact of climate change, desertification and land degradation on LLDCs' economies.

2.1 Vulnerability of LLDCs to climate change, desertification and land degradation

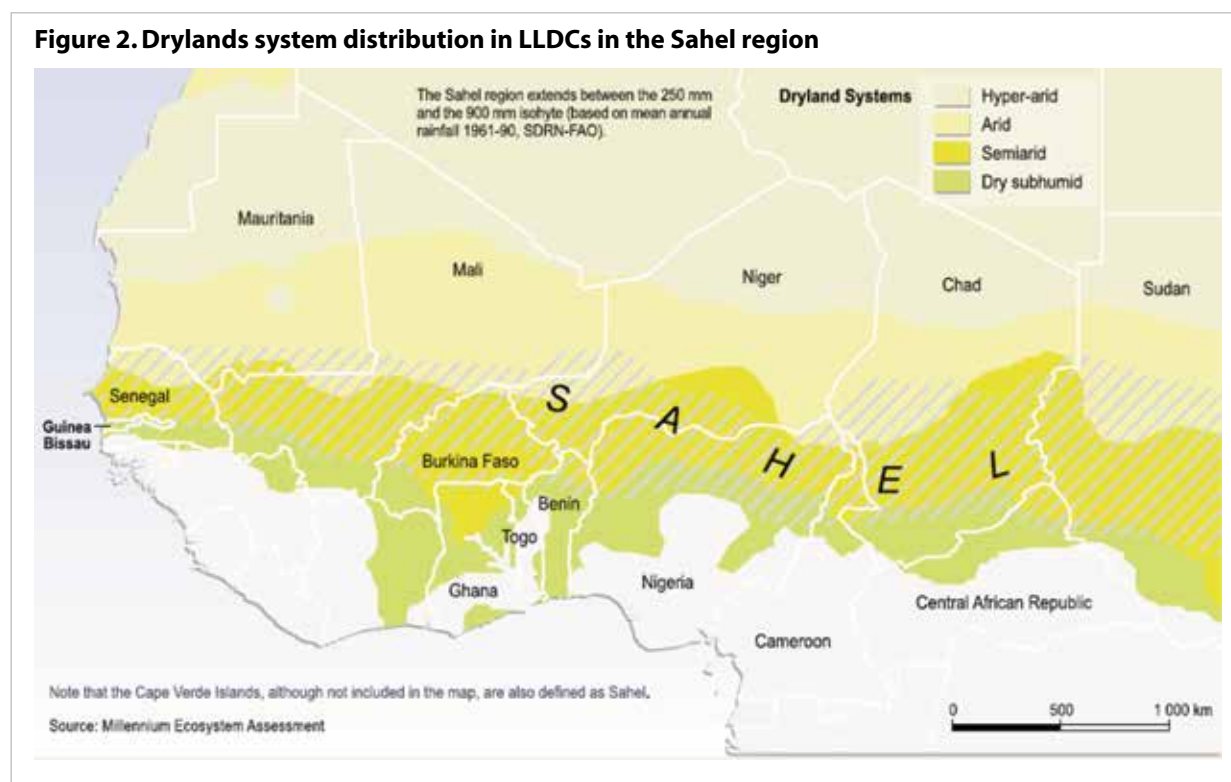
Climate change, desertification and land degradation are global challenges with severe implications for worldwide eco-safety, food security, socio-economic stability, and sustainable development. Among the most affected countries are the LLDCs because they have fewer resources to adapt: socially, technologically and financially. Their economies are highly vulnerable to climate change, desertification and land degradation for a number of reasons.

The first reason for the high vulnerability of the LLDCs is because most LLDCs lack institutional and human capacity to tackle these challenges. The second factor is the fact that many of these countries are too dependent on climate-sensitive resources (e.g. agriculture, livestock, forestry, water, fisheries, etc). High incidences of poverty coupled with high population growth rates are some of the drivers of desertification and land degradation in many LLDCs. Poverty remains high amongst most LLDCs with national poverty rates of more than 40% (except Europe) and comparatively higher than transit developing countries. Human development index (HDI) corroborates the evidence of low development status of most LLDCs especially in Africa and East Asia. Without a viable alternative source of livelihood to help reduce pressure on land, the poor will over-exploit land resources including encroachment on fragile lands for survival (food production, medicine, fuel, fodder, building materials and household items).

Third, most LLDCs command non-diversified economies which are dependent on a few primary agricultural and/or mineral commodities. In 2011, just three export products represented more than 70 per cent of exports from 11 LLDCs and primary commodities alone constitute more than 80 per cent of exports from 10 African landlocked developing countries. Export concentrations ratios for LLDCs increased dramatically since 2003 from about 0.2 to 0.38 in 2011 showing the increased lack of diversification of exports. The LLDCs are thus highly vulnerable to shocks related to climate change and desertification.

Finally, many LLDCs are located in dryland regions where the impacts of climate change, desertification and land degradation are more pronounced. Indeed it is in drylands – where the soils are very fragile, vegetation is sparse and the climate is particularly unforgiving that desertification wreaks havoc. Drylands are unevenly distributed between developing and developed countries: 72% of the global dryland areas are in developing countries compared to 28% in industrialized countries. About 15% of drylands globally are found in LLDCs. In total, 54.4% of total land in LLDCs is classified as dryland compared to 30.3% in transit countries.

The drylands are home to more than 2.1 billion people. Further, about 60% of the population in LLDCs is located in drylands area compared to 35.4% in counterpart transit countries. The largest proportion of people (>90%) living in dryland area is found in Sahel. In particular, as shown in Figure 2, a significant proportion of dryland areas within the LLDCs in the Sahel region fall under the extreme hyper-arid and arid conditions (e.g. Chad, Niger, Central African Republic).



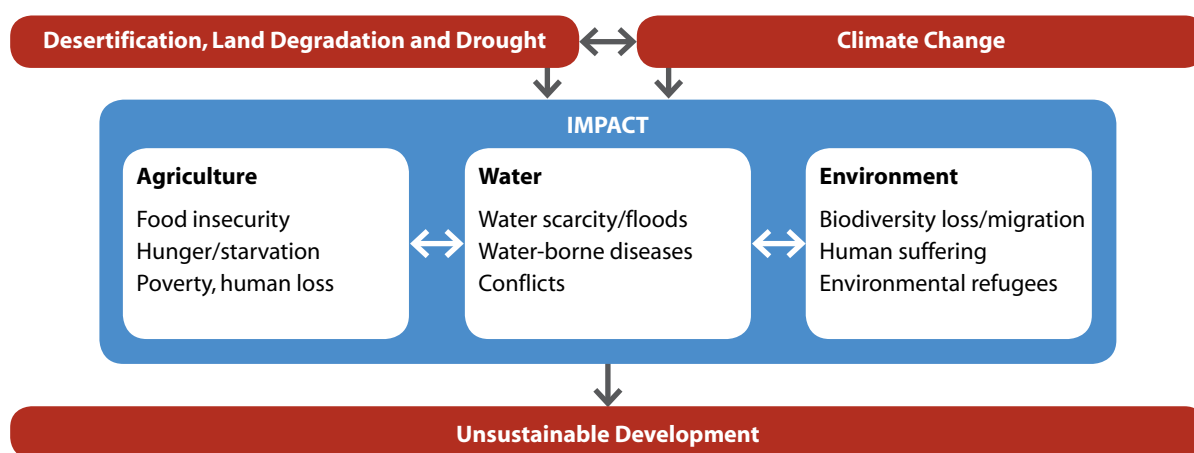
In general, dryland populations, on average lag far behind the rest of the world in human development indicators and face poorest economic conditions (Middleton et al 2011). For instance, the average infant mortality rate (about 54 per 1,000) for all dryland developing countries exceeds that for non-dryland countries by 23% or more. The difference is even worse – 10 times higher – when compared with the average infant mortality rate in industrial countries. Thus the location of LLDCs in drylands makes them more vulnerable to the impact of climate change, desertification and drought.

2.2 Impacts of climate change, desertification and land degradation

2.2.1 Overall economy

The impacts of climate change, desertification, land degradation and drought (DLDD) are channelled into the overall economy mainly through key sectors such as agriculture, water, health and environment. Figure 3 illustrates that the impacts of climate change and DLDD such as extreme weather events, severe droughts, reduced water availability, increased risk of diseases and others on these key sectors ultimately lead to slowed economic growth and general retardation in other development indicators all feeding into an unsustainable development path. The combined effects of DLDD, aided by climate change, are taking a heavy toll on the economies of developing countries and LLDCs in particular. The UNCCD estimates that about 6 million hectares of productive land worldwide has been lost every year since 1990 due to land degradation. A larger proportion of the land loss occurs predominantly in drylands – home to most LLDCs. The land loss translates to income losses of US\$ 42 billion per year.

Figure 3. The impacts of climate change, desertification, land degradation and drought on LLDCs



Due to DLDD, two-thirds of arable land in Africa is expected to be lost by 2025 - representing an annual loss equivalent of more than 3 percent of agricultural GDP for the entire Sub-Saharan Africa region (ECA, 2008). A few examples of LLDCs which have endured heavy losses due to severe problems of DLDD include Ethiopia, Uganda and Zimbabwe. In Ethiopia, GDP loss from reduced agricultural productivity due to land degradation is estimated at \$130 million per year. In Uganda land degradation in the drylands is wreaking havoc and weakening the economy. In Zimbabwe, land degradation predominantly as a result of rampant deforestation is fast transforming the country into a desert.

Table 3. shows a few economic indicators summarized across LLDCs sub-regions. Economic growth rate across all LLDC regions has averaged 3.6 per cent for the past 50 years and generally lower compared to transit developing countries which averaged 4.5 to 5.5 per cent.

Table 3. Regional economic indicators of LLDCs by regions for the period 1960-2012

LLDCs Sub-region	Economic indicators					
	Economic Growth rate (%)	Agriculture % GDP	Export % GDP	Import % GDP	HDI	National poverty rate (%)
LLDCs in Southern Africa	4.8	17.7	39.3	58.1	0.41	53.2
LLDCs in Sahel	2.9	39.5	16.3	29.1	0.30	59.0
LLDCs in East Africa	4.1	42.5	11.8	21.1	0.36	46.2
LLDCs in South America	3.9	16.9	32.4	32.1	0.64	42.2
LLDCs in Europe	1.3	19.1	43.5	64.2	0.62	23.3
LLDCs in East Asia	4.5	34.4	28.4	33.4	0.39	38.7
LLDCs in Central Asia	3.9	25.45	38.9	47.4	0.62	41.8

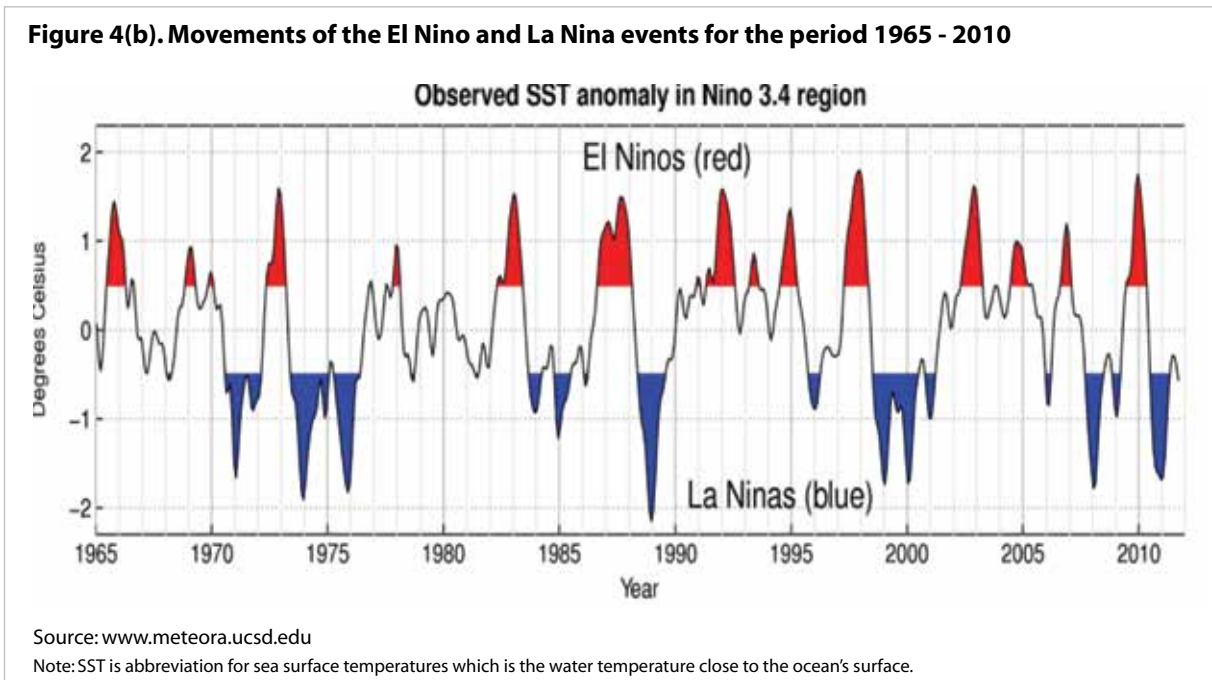
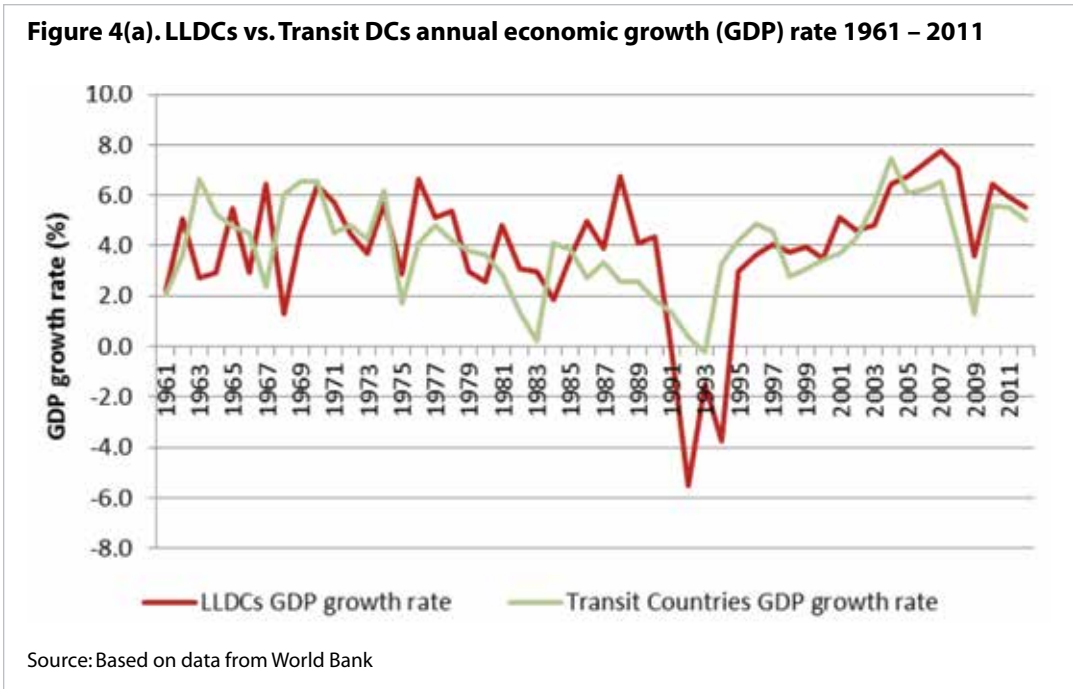
Source: UNCTAD (see Appendices B and C for more detailed statistics)

Economies of LLDCs suffer immensely whenever a natural disaster (particularly droughts and floods) hits the countries either individually or collectively. For instance a series of droughts that affected the Sahel region in 1968 to 1974 and 2011/12, the extreme drought that hit Southern Africa in 1991/92, the catastrophic drought that recently affected the Horn and East Africa in 2010/11, the devastating floods that swept Central Asia in 2000, all demonstrate the severe climate change-related challenges frequently faced by the LLDCs. Images of starving mothers with badly malnourished children on their laps, dead livestock, withered crops, barren soils and etc, all are pieces of evidence pointing to the dire consequences of climate change and DLDD.

The 1991/92 drought resulted in economic growth declining by -0.8% in southern Africa, -1.4% East Africa, 0.7% in Sahel and 1.3% in East Asia. The impacts are not uniform across countries as some are more disproportionately affected than others. For example

countries like Malawi (-7.3%), Ethiopia (-8.7%), CAR (-6.4%) and Mongolia (-9.3%) were among the worst affected. In Zimbabwe, the situation was worse as the drought caused: a 45% drop in agricultural production; a 62% decline in the value of the stock market; a -9% drop in manufacturing output and -11% drop in GDP (see Appendix A).

Extreme events like the devastating droughts (e.g. 1991/92, 2008/09) can help to amplify the impact of climate change-related events on economies of LLDCs. Using El Nino events as proxy variables underlying climate change, Figures 4(a) and (b) demonstrate close movements between El Nino Southern Oscillation (ENSO) events and GDP growth rate for both LLDCs and transit developing countries. Figure 4(a) shows annual GDP growth rate for a period of 50 years (1961 – 2011), while on the other hand Figure 4(b) shows movements of El Nino events for the same period. What is striking to observe is the plunge in GDP largely precipitated by 1991/92 extreme drought episode that affected most LLDCs. The transit developing countries were not spared either as many experienced a huge slump in their GDPs though to a lesser degree than LLDCs.



The movement in key variables (underpinning economic performance of LLDCs) is closely associated with El Nino episodes as indicated by correlation matrix in Table 4. The table shows pair-wise correlation for a few selected variables. The results underlie some important implications: (i) El Nino, a proxy for climate change is negatively correlated with GDP growth rate for LLDCs (-0.26); (ii) economies of Transit developing countries are equally affected by climate change though to a lesser extent as implied by a low correlation value (0.15); (ii) across LLDCs crop yields are significantly correlated with GDP volume (0.89) and GDP growth (0.22); this is also the case with Transit developing countries showing high correlation between crop yield and GDP volume (0.93) but low correlation with GDP growth (0.07). This underscores some important insights – because most LLDC economies are agro-based, climate change impacts affects not only volume of GDP but also GDP growth. For Transit developing countries on the other hand, climate change negatively impact GDP volume but not necessarily GDP growth – a result not surprising since economies of the latter countries are more diversified and not predominantly agro-based. (iii) the result is further supported by the low correlation observed between El Nino and crop yield (-0.09) across Transit developing countries implying less severe impact of climate change on crop yield.

Table 4. Correlation matrix of a few selected variables

	El Nino	LLDCs GDP (volume)	LLDCs (GDP growth)	LLDCs (yield)	Transit Countries GDP (volume)	Transit Countries (GDP growth)	Transit Countries (yield)
El Nino	1.00						
LLDCs GDP(volume)	- 0.13	1.00					
LLDCs(GDP growth)	- 0.21*	0.26*	1.00				
LLDCs (yield)	- 0.13	0.89**	0.22*	1.00			
Transit Countries GDP(Volume)	- 0.15	0.98**	0.26*	0.93**	1.00		
Transit Countries (GDP growth)	- 0.15	0.10	0.76**	0.07	0.11	1.00	
Transit Countries (yield)	- 0.09	0.85	0.19	0.98**	0.90**	0.03	1.00

* Significant at 0.1% level

** Significant at 0.05% level

Having discussed the impact at the aggregate level, the following sections will discuss in more detail impact on different sectors.

2.2.2 Agriculture and food security

The IPCC Fourth Assessment report (2010) on climate change asserts that agriculture, the mainstay for most of LLDCs, is hardest hit sector – by the rising temperatures, loss of suitable agricultural land, increases in soil erosion, land degradation and desertification, shortening of growing season, reduction in crop yields and high frequency and intensity of extreme events and etc, are all affecting agriculture at unprecedented levels. As discussed earlier agriculture is the most dominant economic sector contributing the largest share (%) to GDP for most LLDCs and in some LLDCs it contributes more than 30 per cent to GDP (e.g. Ethiopia, Burundi; see Appendix A). Agriculture is not only a dominant economic sector but also a pillar of livelihood support for millions of small scale farmers and largest employer. Across most LLDCs a majority of the households (> 60%) consists of rural-based smallholder farmers practicing rain-fed agriculture in dry/semi-arid and marginal lands that are highly susceptible to soil erosion and rainfall scarcity. The vulnerability of these farmers is worsened by poor resilience and low adaptive capacity; over-dependence on climate-sensitive sectors (e.g. livestock, forestry, fisheries and water); non-diversified system of livelihood centred on peasant-type of agriculture; production system concentrated on a few crops of low commercial value; lack of human, institutional and technical capacity; poorly developed infrastructure and limited access to information technology, financial services and market outlets.

The negative impact of drought becomes more complex when it occurs with lagged effects which spill over into subsequent years. The situation can be compounded by the occurrence of successive sequential extreme events such as drought-to-drought; drought-to-flood or flood-to-flood series. The 1991/92 and 1993/94 provide good examples of drought-to-drought series to affect southern Africa in a double sequential fashion (see appendix A). Figure 5 compares the volume of GDP in US\$ million (at current) between LLDCs and the transit developing countries for the period 1960 - 2012.

Figure 5. GDP (US \$m) comparison between LLDCs vs. Transit Developing Countries for period 1960 – 2012 (at 2005 constant prices)

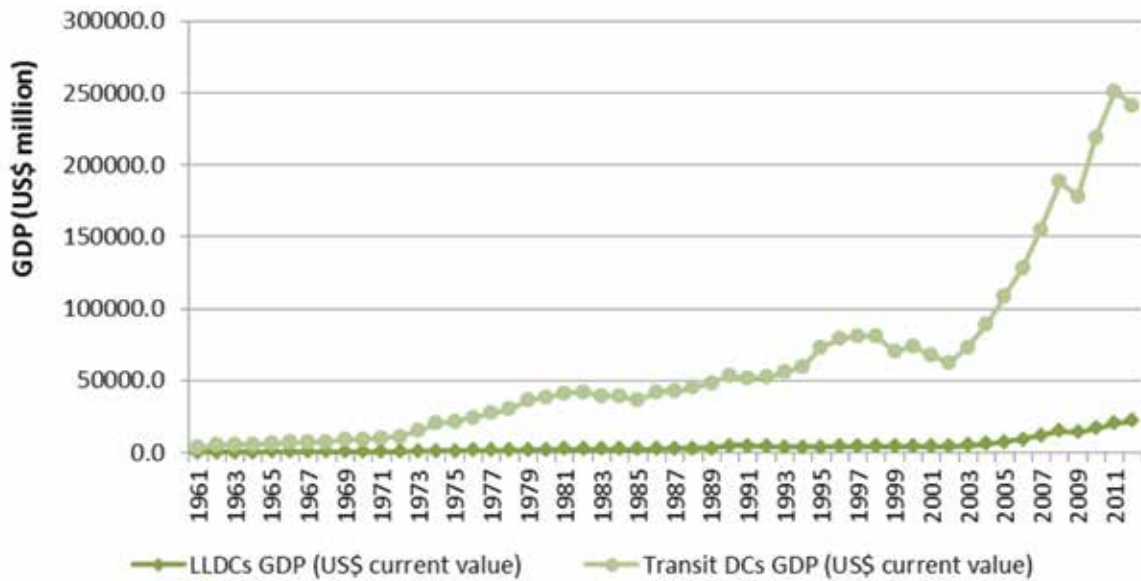


Figure 6. Cereal yield (kg/ha) comparison between LLDCs vs. Transit Developing Countries (1961- 2011)

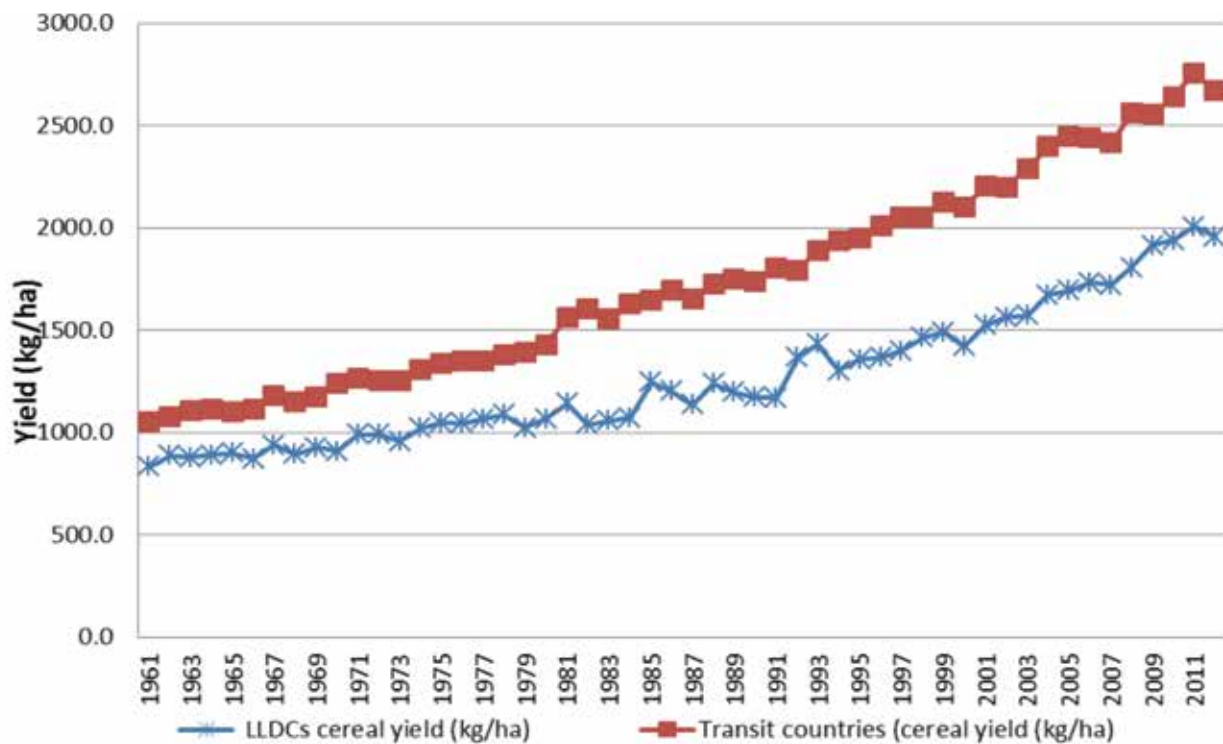


Table 5. Assessment of the impact of climate change and adaptive capacity in LLDCs

Region	Climate variability factor	Impact on sectors					Adaptive capacity of LLDCs
		Agriculture and food security	Water resources	Terrestrial ecosystem	Health		
Sub Saharan Africa	Temperature	<ul style="list-style-type: none"> Agricultural production severely compromised due to: <ul style="list-style-type: none"> • loss of productive land • shorter growing season 	<ul style="list-style-type: none"> • Increase in water stress and scarcity across many LLDCs 	<ul style="list-style-type: none"> • drying and desertification e.g. in Sahel • acceleration in deforestation • increase in forest fires 	<ul style="list-style-type: none"> • alteration of spatial and temporal transmission of disease vectors, including malaria, dengue fever, meningitis, cholera 	<ul style="list-style-type: none"> • Many LLDCs in Africa have low adaptive capacity due to: <ul style="list-style-type: none"> • widespread endemic poverty • weak institutions • low levels of education • limited access to capital • conflicts 	
	Precipitation/ Extreme events	<ul style="list-style-type: none"> • Yield from rain-fed crops could be halved by 2020; • Net revenue from crops could fall by 90% by 2100 • Worsening food security due to extreme drought events; • Increase in number of people at risk from hunger and starvation 	<ul style="list-style-type: none"> • About 75-220 million would face water shortages by 2020 	<ul style="list-style-type: none"> • severe degradation of grasslands 			
Asia	Temperature	<ul style="list-style-type: none"> • decrease in crop yield in many parts of Asia leaving millions of people at risk from hunger 	<ul style="list-style-type: none"> • Increasing water stress due to decrease of freshwater availability 	<ul style="list-style-type: none"> • increased risk of extinction of species due synergistic effects of climate change and habitat fragmentation 	<ul style="list-style-type: none"> • heat stress and changing patterns in the occurrence of disease vectors 	<ul style="list-style-type: none"> • Capacity is constrained due to: <ul style="list-style-type: none"> • poor resource base • income inequalities • weak institutions • limited technology 	
	Precipitation/ Extreme events	<ul style="list-style-type: none"> • reduced soil moisture and evapo-transpiration increase land degradation and desertification 	<ul style="list-style-type: none"> • Increase in the number and severity of glacial melt-related floods 		<ul style="list-style-type: none"> • increase in endemic morbidity and mortality due to diarrhoeal disease 		
Latin America	Temperature	<ul style="list-style-type: none"> • reduction in crop yields though in some areas may see increases in yield 	<ul style="list-style-type: none"> • increase in the number of people experiencing water stress – 7-77 million by 2020 	<ul style="list-style-type: none"> • significant habitat loss and species extinction • loss of groundwater due to higher temperatures 	<ul style="list-style-type: none"> • heat stress 	<ul style="list-style-type: none"> • lack of modern observation equipment and climate monitoring • Limited adaptive capacity 	
	Precipitation/ Extreme events	<ul style="list-style-type: none"> • by 2050, 50% of agricultural lands are very likely to be subjected to desertification and salinization • food insecurity will be severe in land subject to salinization • crop yield will decline due to severe soil erosion 	<ul style="list-style-type: none"> • reduction in water quality due increase in floods and droughts 		<ul style="list-style-type: none"> • risks to life due to increase in the intensity of tropical cyclones 		

Source: Boko et al (2007); Christensen et al (2007); Cruz et al (2007)

As shown in the diagram, the volume of GDP across all LLDCs remains pathetically low compared to Transit developing countries. This does not only reflect relatively weaker economies per se, but also underlies deep seated challenges and constraints affecting LLDCs economies alike. Because many LLDCs' economies are predominantly agro-based, climate change, desertification and land degradation are indeed part and parcel of these challenges. As summarized in Human Development Report (2008), climate change, desertification and land degradation have become the "defining human development issue of our generation."

Multiple studies have sought to highlight the potential impact of land degradation and desertification on food security in developing economies. These studies suggest that poor households particularly those located in dryland ecosystems in LLDCs will be the worst affected. For instance ECA (2007: 11) predicted that if land degradation continues at the current rate unabated, then more than half of cultivated agricultural land in Africa particularly Sahel region could be rendered infertile by the year 2050. As a result if this trend continues, it's estimated that the continent will only be able to feed 25 percent of its population by 2025.

One issue of grave concern regarding impact of climate change and DLDD is the predicted reduction in production yield across LLDC sub-regions. For instance, in Sub-Saharan Africa, crop yields based on rain-fed agricultural production system could be reduced by up to 50 per cent by 2020 (IPCC, 2007). In southern Africa, Lobell et al (2008) predicts that yields of staple maize could drop by 30 percent by 2030 – with dire implications on food security and malnutrition. In Asia, LLDCs are not spared as projections indicate that by 2050, 50 per cent of agricultural lands are very likely to be subjected to desertification and salinization. As a result crop yields are likely to decline due to the severe problems of land salinization and soil erosion (see Table 5).

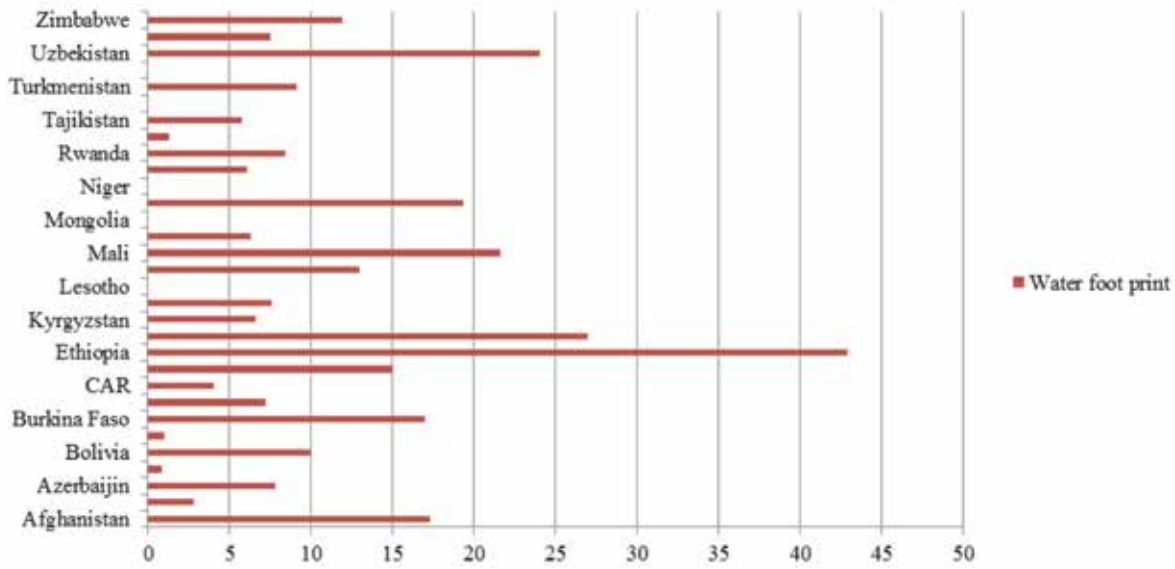
Figure 6 gives a comparison of cereal yield between LLDCs versus transit developing countries for period 1961 to 2012. As observed, transit developing countries are realizing higher yield for cereal crops. For instance, in the case of rice, the yield difference is much larger, with transit countries recording 67 per cent higher yield compared to LLDCs. Region-to-region comparison indicates wide disparities in crop yields and again, transit countries outperform LLDCs (except east Africa). These results underscore important implications: compared to transit developing countries, many LLDCs are more likely to fail in producing enough food grains to meet the national food self-sufficiency; it follows most LLDCs face food deficits and hence are more likely to be more food insecure than transit countries; incidences of diseases associated with food shortage are likely to be higher in LLDCs than transit developing countries.

By virtue of their geographical locations, LLDCs are the most water stressed countries in the world. Figures 7(a) and (b) highlight this problem by comparing the water footprint between LLDCs and transit developing countries. Water footprint is a geographically explicit indicator that shows the volumes of water use available to users, consumers, producers or residents within a country. What is easily observed in these two figures is the low volume of water use in LLDCs compared to transit countries. While transit countries enjoy high water footprint greater than 800gm³/year, the LLDCs on the other hand have 40gm³/year. This underscores the severity of water scarcity in LLDCs which is twenty-fold less than in transit developing countries. Some studies indicate that freshwater availability in LLDCs' drylands is projected to decrease from the current overall average of 1,300 cubic meters per person per year to well below the lowest threshold of 2,000 cubic meters required for human well-being and sustainable development.

The discussion below draws on a few LLDCs to further demonstrate the impact of climate change and DLDD on the economies of these countries. In southern Africa, Lesotho is one country which is badly affected by climate change. The country is characterized by a mountainous topography which accounts for 59 percent of the country's total land area. Less than 10 percent of the total land is arable and suitable for crop cultivation. What is disturbing is that arable land is fast diminishing and according to Lesotho Meteorological Services (2000), it is predicted that this will shrink to 3 percent by 2030. A majority of the population (more than 80 percent) is directly dependent on agriculture and hence agriculture plays a pivotal role in the economic development of the country as it contributes significantly to GDP. For most crops in Lesotho, yields have been decreasing over the past decade. For instance maize yield has plummeted from 1.4t/ha in 1970s to only 0.45t/ha in 2008, a worrisome trend with grave implications on national food security. As a result to meet its domestic demand, the country imports up to 60 percent of grain requirements from regional and/or international markets.

Swaziland is another LLDC located in Southern Africa experiencing the harsh impact of climate change, and DLDD. Like other LLDCs, agriculture constitutes the dominant economic sector with 70 percent of population on it. Sugar is the major agricultural product and essentially the country's main export commodity. Sugar contributes about 18 percent to the GDP, 7 percent to foreign exchange earnings, and 35 percent to agricultural wage employment (Kingdom of Swaziland and European Union, 2007:4). Swaziland's economy also depends on mineral resources, particularly coal. Due to climate change, the contribution

Figure 7(a). Water footprint (in Gm³/year) in LLDCs



Data source: UNEP Geo data (www.geodata.grid.unep.ch)

Note: Gm³ means billion cubic metres

Figure 7(b). Water footprint (in Gm³/year) in Transit Developing Countries



Source: UNEP Geo data (www.geodata.grid.unep.ch)

of the agricultural sector to the country's GDP has declined drastically from 30 percent at independence to 13 percent in 1989 and it fell further to 10 percent in 2009 (Swaziland's Second National Communication to the United Nations Framework Convention on Climate Change).

This impact of climate change on Swazi economy was reiterated by the Minister of Tourism and Environmental Affairs, at the COP 17 meeting (held in South Africa, 2011) to the effect that: *"The Kingdom of Swaziland is highly vulnerable to the impacts of climate change and has the least capacity to adapt... Already we are experiencing the severe negative impacts of climate change which have manifested themselves in incessant drought, wildfires, soil erosion, erratic rains, and wind storms. Therefore, urgent and immediate decisions must be taken here in Durban to avoid further loss and damage arising from the impact of climate change."*

In Malawi, a large proportion of over 90 percent of the people, mostly based in rural communities, earn their livelihood through subsistence farming (United Nations LDC Expert Group; 2011:51). However, the agricultural sector has become increasingly affected by climate change and DLDD. In particular, extreme drought and flood events are the main challenges affecting Malawi and often culminate in decline in GDP growth.

Ethiopia, has suffered severely due to climate change and climate vulnerability, land degradation and drought. Following a series of drought events that hit Ethiopia in 2003, 2009 and 2011, more than 7 million people were left in dire need of food aid and/or food assistance (Republic of Ethiopia; 2011:7). The country also experiences disastrous floods which destroy infrastructure, particularly roads, rails, dams and buildings. As a result, the country often incurs huge and unbudgeted costs to repair the flood-damaged roads and rails which often run into billions of dollars amounting to 11 percent of GDP (World Bank, 2010). Crop and livestock sector are not spared as they often die in large numbers as a result of droughts and floods.

Uganda is one of the LLDCs whose economy depends primarily on coffee exports. It is one of the largest producers of coffee in the world accounting about 2.5 percent of the global coffee production (World Bank: 2011). Coffee is essentially grown by millions of small scale farmers and hence it plays a pivotal role in sustaining the livelihoods of rural populations. In 2008-2009, coffee exports accounted about 25 percent of the country's total export earnings (Republic of Uganda, 2009). However, coffee production in Uganda has been adversely affected by the outbreak of pests and diseases such as coffee wilt, coffee borer, and leaf rust. In 2009 for instance, coffee wilt disease destroyed over 50 percent of robusta trees. This has been compounded by increasing episodes of drought and erratic rain influenced by climate change.

In Latin America, Bolivia is one LLDC that has suffered the disproportionate impact of climate change. In particular, the agricultural sector is one of the most vulnerable sectors to the effects of climate change. The Bolivian agricultural sector, like other LLDCs, is rain-fed and largely subsistence oriented, supporting millions of smallholder farmers. Major crops include potato, maize, soybean and quinoa. Extreme drought and flood events are largely responsible for the losses experienced in Bolivia. In 2002 and 2003, the country experienced a severe drought resulting in severe loss in agricultural production. In 2006 hundreds of thousands of hectares were damaged by floods and according to UN Office for the Coordination of Humanitarian Affairs (2006), more than 100,000ha of agricultural land was washed away by extreme floods along with a total of 64,000ha of maize, soy, rice and sorghum and 30,000 ha of pasture land.

In Asia, Uzbekistan (a double land-locked country), is one country enduring the heavy impact of desertification. Almost 80% of the land area of the country is comprised of deserts and semi-deserts, with Kyzylkum being the largest desert of Central Asia. By virtue of being located in the most arid belt of Asia, Uzbekistan is highly susceptible to desertification, land degradation and climate change. It is estimated that more than 52% of the arable lands and 73% of grasslands are presently undergoing degradation. The situation is aggravated by the fact that local farmers have limited experience and knowledge on how to use soil and water conservation technologies for promoting the best practices of sustainable land management.

In Nepal, agriculture is the dominant sector as it employs more than 65 percent of the total population and it accounts for around 33 percent of the country's GDP. However, the sector is vulnerable to recurring climate related events such as flash floods, landslides, intense rains, droughts, hailstorms, cold and heat waves, soil erosion and mass movements. These events have severely undermined cereal production in the country. Table 6 illustrates the loss of agricultural land and cereal due to climate related extreme events from 1971 to 2007.

Table 6. Loss of agricultural land and crops to climate-related extreme events in Nepal 1971-2007

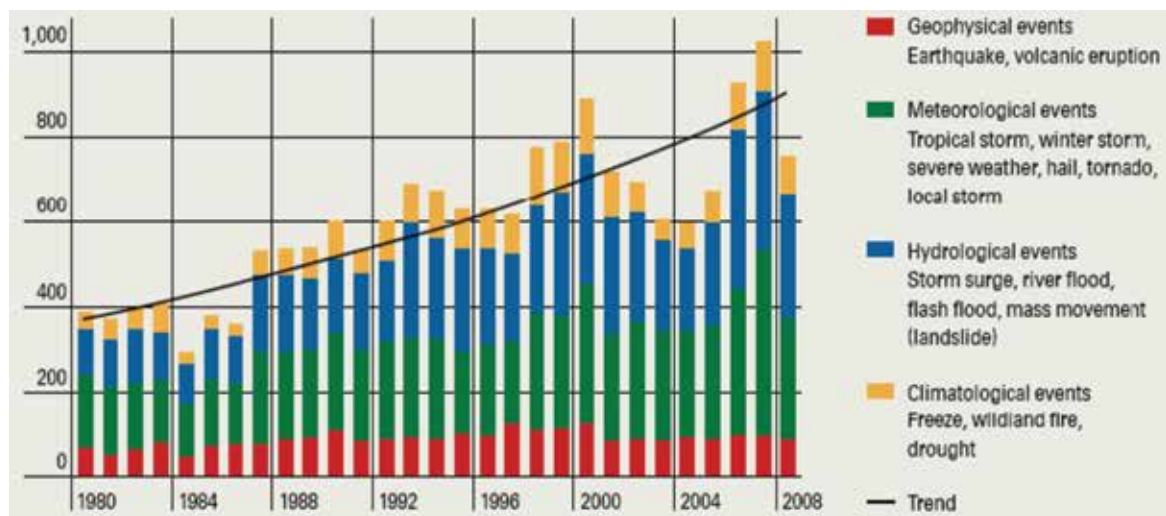
Event	% Loss of agricultural land and crops
Droughts	38.8
Floods	23.2
Hailstorms	13.8
Rains	6.5
Strong winds	2.7
Cold waves	2.6
Others (forest epidemic, snow storm, fire, storm, thunderstorm, avalanche, plague, etc.)	9.8
Total	100

Source: Nepal National Report to UNFCCC (2007)

2.2.3 Extreme climate events

Climate change is strongly associated with the occurrence of extreme weather events such as droughts, floods, cyclones, typhoons, and other destructive weather disasters. The observed trend in the occurrence of extreme events worldwide, bear testimony to the increasing frequency and intensity of climate change related calamities (see Figure 8). Extreme events are hugely disruptive as they cause a trail of extensive damage and destruction of properties, infrastructure particularly roads, bridges and dams, and even more tragically, the loss of human life and livestock. Extreme droughts necessitate the intervention of the international community as the affected countries become so overwhelmed and unable to contain the nation-wide emergency situation. This involves emergent and massive importation of grain cereals whose transportation costs from ports to inland destinations are prohibitively high and unaffordable as many of these LLDCs are too poor. Worse still, because often the entire region becomes affected by a catastrophic drought/flood event, this means the affected LLDC cannot import from within the region. Rather the imports are only sourced from remote international markets and the costly burden of transporting the bulky food commodities and the handling of logistics are beyond the reach of an individual LLDC. It's not surprising that under emergency food-aid situations, many LLDCs rely on the goodwill of non-governmental organizations, development agencies and the international community at large.

Figure 8. Trends of catastrophes worldwide 1980-2008



Source: Dixit *et al.* 2009

The Sahel is one region in Africa that has experienced the ravages of extreme events. For instance a series of severe droughts hit the region during the 1970s in what has come to be coined “the quintessence of a major environmental emergency” (World Meteorological Organization; 2005: 17). It is estimated that close to a quarter of a million people lost their lives in the Sahel as a result of these extreme drought events (Gonzalez; 2002:2).

In Asia, Mongolia provides a typical example of an LLDC that has experienced an array of climate change-related disasters characterized by snowfalls, sandstorms, aggressive winds, snowstorms, hail, and floods. These harsh climatic conditions pose the most formidable challenge to the development of Mongolia. Climate change and climate variability has badly affected nomadic pastoralism which is one of the key agricultural sectors in the country. In particular recurrent droughts and dzud are some of the severe challenges which have affected nomadic livestock agriculture. Dzud is a local term used to describe the extremely cold winter marked by heavy and protracted snowfall, low cold temperatures and wind storms. The dzud deprives livestock of grazing and drinking water and animals die in scores as a result. The dzud does not only affect livestock but also causes a drastic drop in crop yields. This also gives rise to socio-economic problems such as increase in unemployment, poverty, massive rural-to-urban migration which largely emanates mostly from remote and underdeveloped regions.

Extreme events have also undermined the health status of many people in other LLDCs particularly those located in remote rural and often inaccessible areas. In Tajikistan, extreme floods caused by climate change (during periods 1998 and 2000), resulted in an increase in outbreak of water-borne diseases (especially malaria, cholera and dysentery). The floods also caused the destruction of physical infrastructure, the degradation of productive land, siltation of water resources, loss of livestock and reduction in food production (Tajikistan’s First National Communication: 2002; 61).

In Bhutan a large proportion (79 percent) of the population is dependent on subsistence farming. The country as a whole is highly vulnerable to unpredictable monsoon patterns and its infrastructure has been affected by recurrent landslides and flash floods. This in turn hampers the economic development of the country (Royal Government of Bhutan, National Environmental Commission, 2012).

In East Europe, Armenia experiences a range of climate change-related disasters, particularly mudflows and landslides. It is estimated that each year the country loses an average of USD 33 million as a result of damages occasioned by extreme climate events (Stockholm Environment Institute and UNDP Armenia; 2009: 13).

In Latin America, Bolivia is highly vulnerable to extreme events, particularly floods and droughts. In turn these events are shown to be heavily influenced by El Nino and La Nina phenomena. For instance, the 1997/98 great El Nino event caused a total loss of USD530 million – approximately 2.2 percent of GDP. From 2006-08, the country experienced a series of extreme events characterized by hail, frost, river overflows, landslides and floods. A significant number of people were affected, for instance over 560 000 people were affected in 2006/07, while 618 000 were affected in 2007/08 (Oxfam International; 2010: 20). Table 7 shows climate change risk indicators and average loss of human lives recorded in seven South American countries for the period 2006-2008. Across the entire region, the indicators reflect that Bolivia was the hardest hit.

The agricultural sector is also not spared as severe losses were recorded in crop and livestock sectors. The events negatively affected yields of several key crops such as soy, maize, yucca, sugar cane and rice. This has forced many people to migrate, causing severe displacement of people within the country.

Table 7. Climate change risk indicators and associated losses in South American countries

Country	CIR assessment 1998-2007	Average death rate	Average rate of deaths per 100,000 Inhabitants	Average total losses (million US\$ PPP)	Average GDP loses in %
Bolivia	13.42	131.00	646.46	1.38	3.9
Brazil	70.00	71.00	63.10	0.04	0.00
Chile	92.83	10.00	0.04	0.06	0.00
Colombia	67.50	67.00	2.32	0.15	0.00
Panama	97.92	2	0.24	0.06	0.00
Venezuela	98.00	5.00	1.36	0.02	0.00
Argentina	71.33	21.00	32.54	0.05	0.01

Source: GermanWatch 2009.

2.2.4 Environment and biodiversity

Biological diversity is important in a range of respects including cultural, economic, social, recreational, scientific, educational, genetic and ecological functions. According to the Millennium Ecosystem Assessment, climate change has the potential to become the major direct driver of the loss of biodiversity by the end of the 21st century. Many studies have also reiterated that climate change is expected to adversely affect forest biodiversity in a number of ways such as reducing the ability of forests to provide soil and water protection – habitat for different species and other essential ecosystem services. Climate change affects biodiversity mainly through changes in distribution and reproduction, increased extinction rates and changes in the length of growing seasons for plants. It causes loss of biodiversity, which in turn contributes to land degradation, desertification, food insecurity, depletion of water resources, and increased vulnerability.

Because of its relationship with ecotourism, biodiversity is one of the most important drivers of the economies of LLDCs. In Botswana for instance, the country has some of the rare biodiversity systems, which play a major role in meeting and sustaining the livelihoods of a majority of people, particularly in rural areas. Half of the country's population lives in rural areas and depends directly and indirectly on biodiversity. Most tourist activities in the country are centered on biodiversity. However, there has been a significant reduction in biodiversity due to climate changes and desertification.

In Nepal, the impact of climate change on biodiversity has been well pronounced across the country. According to Nepal's fourth national communication to the Convention on Biodiversity (2009), the country's ecosystems are being reduced at a highly disturbing rate due to factors such as climate change, forest fires, habitat destruction, poor land uses, overexploitation of resources, poverty and increasing human population. Nepal has some of the world's "biological hotspots" particularly in places such as the Himalaya. Events such as veld fires, flooding from snow melting, pest and disease outbreaks are contributing to biodiversity loss. These events have caused a disturbing decrease in many species, including highly valued medicinal plants.

A special type of ecosystem that characterizes many LLDCs is the mountainous landscape. LLDCs like Mongolia, Bhutan, Nepal, Swaziland, Ethiopia and many Central Asian countries (Kyrgyzstan, Uzbekistan, Tajikistan and Kazakhstan) have landscapes which are predominantly rocky, hilly and mountainous. A majority of dryland mountains are unique in terms of biodiversity, but this extraordinary wealth is critically endangered by threats such as the overexploitation of natural resources, land conversion into unsustainable land uses, altered hydrologic and fire regimes, pollution, unsustainable population densities, armed conflicts, and the invasion of exotic species leading to desertification processes. This explains why dryland mountains are considered a priority area under UNCCD and the Convention on Biological Diversity (CBD).

Inappropriate farming systems such as continuous cultivation without adding any supplements, poor land management practices, lack of soil and water conservation structures lead to land degradation and aggravate the process of desertification. The rate of land degradation is particularly high when cultivation takes place on marginal lands such as arid and semi-arid lands, hilly and mountainous areas and wetlands (ECA, 2007). Other farming practices like mono-cultivation also worsen land degradation. In Africa overgrazing and over-cultivating are converting 351,000 hectares of land into desert each year (ECA, 2007). For most LLDCs in Central Asia, irrigation systems are largely to blame for increasing soil salinity. Salinization occurs in irrigated cropping systems when evaporation removes the water from waterlogged soils and leaves increasing salt levels in the soil. This results in the build-up of salts which in turn makes the soil less fertile. Table 8 shows the extent of soil salinity, soil erosion and percentage of area affected, across Central Asian landlocked countries (Kazakhstan, Kyrgyzstan, Tajikistan, Turkmenistan and Uzbekistan).

Table 8. Soil salinity, erosion and irrigated area affected by salinity across Central Asian LLDCs

Country	Salinity (% of area affected)	Erosion (% of area affected)	% of irrigated area (affected by salinity)
Kazakhstan	7.91	2.87	33.0
Kyrgyzstan	0.50	28.21	11.5
Tajikistan	4.89	25.86	16.0
Turkmenistan	14.91	1.43	95.9
Uzbekistan	14.13	2.92	50.1
Central Asia	8.99	4.78	47.5

Source: IFPRI 2008 (in Nkonya, 2011)

Most of the mountainous LLDCs are endowed with dry forests, woodlands and scrubland including multiple endemic plants and species diversity. For instance the hyper-arid mountains of the Sahel region are the home to Acacia woodlands and some very threatened endemic and relic tree species (FAO, 2011:32). Dryland mountain forest can contribute to livelihood diversification and can play a significant role in the uplifting of rural economies across mountainous LLDCs. Products such as gums, resins, honey, cork, medicinal plants and mushrooms are probably the most feasible and easily marketable products obtainable from dryland mountain. Medicinal and aromatic plants are important components of these forest landscapes and can play a significant role in the economy of rural households, both for self-consumption and trade in ways that promote the much-needed livelihood diversification in LLDCs. For instance FAO (2011) reports that from the mountain forests of Nepal an estimated 470,000 households are engaged in the commercial collection of medicinal plants. The mountainous region of southern Africa (especially Swaziland) is also a major source of raw material for herbal trade, with approximately 900 species recorded with specific medicinal uses (FAO, 2011).

But the LLDC mountainous regions suffer severe land degradation and soil erosion and are home to many of the world's poorest and hungriest people, where living conditions and livelihoods are among the harshest and most difficult in the world. While the understanding of the global significance of mountains is increasing – principally as the source of most of the world's fresh water and home to a wealth of biodiversity ranging from important food crops such as potatoes to medicinal plants of tremendous value – the policy support remains insufficient in many LLDCs.

It is important for LLDCs to adopt initiatives which are intended to preserve biodiversity in mountainous areas. One way of doing this is through the adoption of sustainable mountain development strategy. It is a holistic approach which involves sectors such as water resources management and development, preservation of biodiversity, infrastructural development and the promotion of tourism. Different stakeholders such as the government, the private sector, local communities and the international community should be involved in this process. Sustainable mountain development also involves raising awareness among mountain communities regarding issues such as the problems and opportunities of mountain ecosystems and effective ways of addressing their fragility. It is important for sustainable mountain development to assume a hybrid nature, that is, taking into account traditional land use and management practices as well as the use of new technology and the adoption of modern soil and water conservation mechanisms. It is also important to adopt initiatives which diversify the livelihoods of mountain communities so that they do not over rely on certain resources.

2.2.5 Water resources and human migration

DLDD will continue to impact negatively on water resources and water availability in already water-stressed regions. Drylands ecosystem in particular, where most LLDCs are located, will become drier. Under IPCC scenarios, predictions point to the upsurge in frequency of occurrence, duration and increased intensity of extreme climate events particularly drought. As drought conditions are projected to worsen, water scarcity will become very acute and will constitute one of the greatest constraints to economic growth and development affecting developing countries (UN-Water, 2010). For instance in Africa, climate change is expected to intensify the continent's increasingly critical water situation. A reduction in annual average rainfall and its run-off would worsen desertification particularly in Sahel and Southern Africa regions. These sub-regions, being some of many water-stressed regions, could see a further decrease in streams flow and the ability of groundwater to 'recharge' (ECA, 2007).

A combination of decreasing precipitation, high temperatures resulting in high evaporation rates and drastic reduction in rivers flow, will mean accelerated reduction in water availability in dams, lakes and water reservoirs. In turn, this will negatively impact water availability for irrigation agriculture. For instance within the Sahel, the major cause of concern has been the depletion of water in Lake Chad, which has already decreased in size by about 50 percent in the last 40 years (UN-OHRLS, 2009:16). For the Niger River Basin, which covers LLDCs like Mali and Niger, a possible 10 percent change in precipitation and potential evaporation would drastically reduce runoff and will cause dire consequences on water availability for agriculture, industry and household consumption. ECA (2007:11) predicts that by the year 2025, nearly 230 million Africans predominantly LLDCs will face acute water scarcity, and 460 million will live under water-stressed conditions. The situation will be further exacerbated by land degradation and desertification and will lead to perilous food security and economic underdevelopment.

According to the IPCC report (2012) water will be among the most adversely affected natural resource due to climate change and climate variability. The report projects fresh water being highly vulnerable to climate change with dire consequences on human societies and ecosystems. Projections also indicate that many people especially in Africa will face severe water stress by 2025. A reduction in water quantity also causes livestock mortality, loss of biodiversity and conflicts (especially in pastoral

communities). Climate change also negatively impacts the quality of water. Reduced water quality increases incidences of water borne diseases such as diarrhoea, cholera, bilharzia, etc.

Lesotho is experiencing severe depletion in water resources particularly its wetlands. It is endowed with alpine wetlands which are a rare ecological feature in Southern Africa. They have an essential hydrological role and they directly and indirectly sustain the livelihoods of many people in the country. However, these wetlands have been exposed to increased stress due to climate-related events such as siltation, erosion, encroachment by cultivation, increased pressure on resources and bad land use practices. There is a rise in the degradation of wetland vegetation cover and this causes increased deterioration of wetlands.

Armenia has vast water resources which are increasingly under threat due to climate change. For instance, Lake Sevan, one of the largest fresh water sources, has experienced dwindling river flows due to climate change projected to decrease by 6.7, 14.5 and 24.4 percent by 2030, 2070 and 2100 respectively (Republic of Armenia, Ministry of Nature Protection; 2010). In 2001, the World Bank, after observing a sharp 44 percent decline in water levels, declared Lake Sevan an environmental disaster.

Bolivia, like Armenia, possesses abundant water resources. However, climate variability due to erratic precipitation, high temperatures and high frequency of extreme events are putting water resources under increasing pressure. Bolivia has some glaciers which has sustained the livelihoods of many people especially in rural areas. However, in recent years the glaciers have begun to melt primarily due to the rise of temperatures and this is negatively impacting on the country's water resources. According to Weinberg (2010), the country has experienced the following challenges;

- In 2009 the 18 000 year old Chacaltaya glacier overlooking the country's capital city disappeared thereby threatening water supplies to the city
- In the same year, the water levels in lake Titicaca (which supports about 2.6 million people) dropped 2.6 feet, reaching its lowest level since 1949 and
- The rain season in the Altiplano has shifted from six to three month period thereby prompting drastic water rationing in Altiplano towns and cities.

The negative impact of desertification extends beyond the affected dryland areas (ECA, 2007:14). As the level of land degradation and desertification exceed beyond the redeemable threshold, the affected households will be forced to migrate. Desertification is increasingly displacing a large mass of people – forcing them to leave their homes and lands in search of better livelihoods. In recent literature such migrants are referred to as 'environmental refugees'. At greatest risk are the poor who constitute a majority in LLDCs. In LDCs and LLDCs, the migrants often settle on the outskirts of urban areas or coastal zones (Chan, 1995, in ECA 2007:14). They frequently settle on areas ill-suited for human settlement where water and sanitation provision is a challenge. Migration is viewed as a coping mechanism that takes place only when the hopes of continual sustenance of livelihood at current locations are completely shattered due to long-run land degradation, desertification and drought.

Pastoralists provide a good example in this regard. In LLDCs like Ethiopia and Uganda, deterioration of pastures due to land degradation and desertification forces pastoralists to migrate hundreds of kilometers away in search of better pastures. This raises competition over finite pastoral resources and increases conflicts (Meier and Bond, 2005, in ECA 2007:14). ECA estimates that 60 million will move from the desert-prone areas of Sahel towards Northern Africa and Europe by the year 2020. In Burkina Faso, desertification has been identified as the main cause of migration. Currently most of the urban centers are swelling with people, a majority (60 percent) being "environmental refugees". The swelling population in city centers will put additional strain on already stretched public infrastructure especially water and sanitation provision.

2.2.6 Transport and Energy

Changes in temperature, sea-level rise, precipitation, and storm activity all may have significant implications for transport infrastructure design, operations, and maintenance. In particular the degradation of road infrastructure due to climate change presents a serious economic threat to many LLDCs whose road network remains largely undeveloped. For instance, excessive precipitation can cause severe damage particularly on unpaved roads, while on the other hand extreme temperatures (cold/hot) can cause severe damages especially on paved roads. Some studies have shown that maintenance for precipitation-damaged roads can account for 4% of total maintenance costs while temperature-damaged maintenance can account for 36% of costs (Miradi, 2004, in Chinowsky et al, 2011). The African Development Bank has called for an estimated US\$40 billion per year to help African nations address the challenges associated with climate change – transport sector included.

Since most of the roads are unpaved across many LLDCs (as discussed earlier), this means that road infrastructure in these countries is highly susceptible to climate change-related damages, e.g. excessive precipitation and extreme temperatures. Improved climate-proof roads will provide a lifeline to the economies of most LLDCs and will play a crucial role in national poverty reduction and alleviation programmes. For instance, an improved and expansive road network, especially one that taps deep into remote rural areas, will provide an essential link to commodity markets for millions of smallholder farmers– a majority currently lacking such access.

In their study, Chinowsky et al, (2011) illustrate the impact of climate change on road infrastructure based on “with and without” adaptation scenarios. For instance Table 9 shows the impact results for Ethiopia. As illustrated, the data indicate that initially maintenance costs rise for existing paved roads which are not designed for climate change effects. However results indicate that costs decline as adaptation takes roots and the effect of climate change is moderate through 2050. Thereafter, as climate change effects increase a greater proportion of the expenditures is needed to offset the potential damage to the roads. The key message to note is how adaptation significantly decreases the cost of climate change as paved roads are constructed with “enhanced drainage, permeable bases and asphalt mix designs” among other adaptations that accommodate the precipitation and temperature increases.

Table 9. Illustrating climate change impact costs for Ethiopia by decade through 2100

Decade	Total cost of climate change with adaptation (\$million, 2009 USD)	Total cost of climate change without adaptation (\$million, 2009 USD)
2020	3.2	3.0
2030	3.2	3.1
2040	11.5	12.0
2050	49.5	50.2
2060	16.2	41.1
2070	25.4	57.0
2080	12.0	47.5
2090	10.0	41.2
2100	7.0	53.6

Source: Chinowsky et al, (2011)

Energy is one of the economic sectors negatively impacted by drought and desertification primarily via the losses in hydropower potential for electricity generation (ECA 2007:14). Some of these impacts are illustrated for a few selected LLDCs in Africa (see Table 10). In the case of Uganda, reduction in water levels at Lake Victoria reduced the hydro-power generation by 50MW. Factors such as land degradation, (particularly siltation and sedimentation), high evaporation (due to rising temperatures), drought and desertification, all combine to reduce water levels in Lake Victoria. Climate change is likely to worsen the situation. In other countries, it’s largely the extreme drought events which negatively impact the hydro-power generating capacity.

Table 10. Electricity-related impact for selected LLDCs in Africa

Country	Period	Consequences
Uganda	2004-05	Reduction in water levels at Lake Victoria resulting in reduction in hydro-power generation by 50MW
Lesotho	1992	Hydro operation limited to 6 months, leading to 20 percent reduction compared to 1991
Malawi	1997-98	Engineering operations affected by drought. Amount of hydro energy generated was 6 percent less than years of normal rainfall.
Zambia	1992	Poor rainfall resulted in a 35 percent reduction in hydro generation in relation to previous year
Zimbabwe	1993	Drought led to a drop of over 9 percent in energy production compared to 1992

Source: African Energy Policy Research Network, 2005 (in ECA, 2007)

LLDCs like Tajikistan have declared the development of hydro-energy its top priority. The development of hydro-energy and renewable energy will ensure environmental sustainability and reduce the detrimental carbon emissions – key in addressing climate change. Tajikistan possesses a huge hydro-energy potential which needs to be tapped so as ensure universal access to modern and cost efficient energy services as well as enlarging its share of renewable energy and increase investments in this sector. In particular, the declaration by UNGA (2012) provides a unique window of opportunity to assist LLDCs in developing renewable energy.

2.3 Summary

This section has highlighted the social, economic and environmental impacts of climate change, desertification and land degradation on the economies of LLDCs. The section has also highlighted that LLDCs have special vulnerabilities to climate change and DLDD because of their geographical location in drylands and the fact that they are already economically disadvantaged as they are not able to fully harness their development potentials particularly trade due to substantially higher trade transaction costs as a result of being landlocked. The next section discusses the interventions and support measures to help mitigate the impacts.

3.0 Introduction

Climate change, desertification and land degradation have become major contemporary challenges to the development agenda of the global community. The imperative to fight climate change continues to attract global attention. At the international level, UN and other international development agencies are leading the efforts towards mobilizing financial, capital, institutional and technical resources directed at assisting developing countries to tackle the urgent problems of climate change, desertification and land degradation. At the regional level, developing countries are joining hands to find a common ground, and to chart regional strategies to combat climate change. At the national level, countries have adopted a myriad of measures intended to ameliorate and strengthen their capacity to mitigate and adapt to the impacts of climate change. In this section, interventions on climate change, desertification and land degradation are discussed and analysed at three broad levels – international, national, and regional.

3.1 National interventions on Climate Change

Article 4 of the UNFCCC mandates Parties to consolidate their Commitments by way of “formulating, implementing, publishing and regularly updating national measures to facilitate adequate adaptation to climate change”. The Article under clause 8 provides for Parties to “give full consideration to meet specific needs and concerns of developing country Parties arising from the adverse effects of climate change and/or the impact of the implementation of response measures, especially on” countries that are highly vulnerable to climate change including “countries with fragile and mountainous eco-systems” as well as “land-locked and transit countries”. Additionally, provisions of Article 12 (4) provides for developing country Parties to “propose projects for financing, including specific technologies, materials, equipment, techniques or practices that would be needed to implement such projects”.

As a result a number of interventions, and key amongst them the National Adaptation Programs of Action (NAPAs) under the auspices of UNFCCC, have been widely adopted by LDCs as measures to address climate change. Under NAPA each LDC is required to identify and produce a list of priority actions that are “urgent and immediate” to address the impact of climate change. Table 11 shows that significant progress has been achieved as more than half of the LLDCs (that are also LDCs) have successfully completed preparation of NAPAs (by May 2013) and are now at different stages of implementing the identified projects (www.unfccc.int). Only the first three identified project areas (as selected by each country) in the “order of priority”, are listed and this provides some important insights: In their submission the LLDCs picked in common ‘water resources, agriculture, disaster risk management and early warning systems’ as priority sectors in need of “urgent and immediate” action to address climate change. This is perhaps understandable for the following reasons:

- Because most LLDCs are located in drylands (as illustrated earlier), fresh water availability is proving to be the most limiting resource due to climate change and desertification; improvement in water resource management, therefore, – including investment in water infrastructure – will shape the future of LLDC economies;
- Water resources and hydro-energy are intertwined. For instance, many LLDCs have raised concern on how their economies are impacted when hydro-generating capacity becomes compromised as a result of depletion in water levels in lakes, rivers, etc

due to high evaporation that is fuelled by climate change, land degradation, drought and desertification. In particular, extreme events such as droughts have the most profound impact on hydro-power generating capacity.

- The agriculture sector – in particular sustainable livelihoods, food security and livestock – is central to most economies of LLDCs;
- Disaster risk management and early warning mechanisms necessitated by the threats posed by climate change-related extreme events (e.g. floods, droughts, cyclones, etc) are crucially essential to reduce LLDCs' vulnerability and improve adaptation and resilience to climate change.
- Terrestrial ecosystem, in particular, policies that aid land restoration and rehabilitation, land protection and conservation will help address problems of desertification and land degradation.

Table 11. NAPA project list by LLDCs (May 2013)

Country	Project components in order of priority			Total projects	Total cost (US\$ million)
	1	2	3		
Afghanistan	Water resources – improved water management and user efficiency	Water management, land rehabilitation and agriculture	-	2	4.4
Bhutan	Disaster risk management and early warning	Terrestrial ecosystem – wetland ecosystem	Weather forecasts and early warning	9	6.9
Burkina Faso	Disaster risk management and early warning	Agriculture – food security	Terrestrial ecosystem –restoration and management of wetlands	12	5.8
Burundi	Disaster risk management and early warning	Terrestrial ecosystem – rehabilitation of degraded land	Terrestrial ecosystem –safe guard natural environment	12	7.3
CAR	Capacity building and education	Terrestrial ecosystem – promoting urban forests	Terrestrial ecosystem – restoration of degraded pastoral areas	10	3.0
Chad	Water resources	Agriculture – food security	Capacity building and education	10	14.0
Ethiopia	Agriculture – promote drought insurance	Early warning system –	Water resources – water harvesting and irrigation	11	769.0
LAO PDR	Agriculture – disaster management	Agriculture – capacity building	Agriculture – capacity building and land management	12	23.7
Lesotho	Agriculture – improve resilience of livestock production system	Agriculture – promote sustainable livelihoods and food security	Capacity building – integration of climate change	11	12.8
Malawi	Agriculture – sustainable livelihoods and food security	Terrestrial ecosystem – reduce siltation	Agriculture – improve production under erratic conditions	5	22.9
Mali	Agriculture – improve crop extension and adaptation to climate change	Agriculture – improve livestock extension and adaptation to climate change	Agriculture – livelihood diversification	19	49.8
Nepal	Agriculture; Water resources and forestry	Agriculture – enhance adaptive capacity of vulnerable communities	Early warning – community based disaster risk management	9	350.0
Niger	Agriculture – fodder and pastoral system	Agriculture – creating livestock food banks	Agriculture – restoring basins for crop irrigation	14	-
Rwanda	Terrestrial ecosystems – land protection and preservation	Early warning system – capacity building	Water resources – irrigation development	7	8.0
Uganda	Terrestrial ecosystem – community tree growing	Terrestrial ecosystem – land degradation management	Early warning weather and climate information	9	39.8
Zambia	Early warning – disaster risk management	Agriculture – food security and livelihood diversification	Water management; Capacity building and livelihood diversification	10	14.7
Total					1,332.1

Source: UNFCCC, 2013 (www.unfccc.int accessed November 02, 2013)

The discussion below draws on a few LLDCs to demonstrate how they have developed their NAPAs in alignment with national development programs. In Southern Africa Lesotho is one of the LLDCs most vulnerable to climate change. It has embraced the NAPA as one of the key elements for national poverty reduction. The Lesotho NAPA process identified and prioritized the eleven adaptation activities which it seeks to implement in the various vulnerability zones. These projects will address the adaptation needs of communities within, and shall build capacity within designated vulnerable communities. These projects have been organized in a hierarchy of importance and order of priority as listed in Table 12. The first three are the most “urgent and immediate” priority activities that the country seeks support and would like to implement as a baseline adaptation measure followed by other subsequent priority activities.

Table 12. Lesotho priority list of identified NAPAs

Order of priority	Activity description
1	Improve resilience of livestock production systems under extreme climatic conditions in various livelihood zones in Lesotho
2	Promoting sustainable crop based livelihood systems in foothills, lowlands and senqu river valley
3	Capacity building and policy reform to integrate climate change in sectoral development plans
4	Improvement of an early warning system against climate induced disasters and hazards
5	Securing village water supply for communities in the southern lowlands
6	Management and reclamation of degraded and eroded land in the flood prone areas (pilot project for western lowlands)
7	Conservation and rehabilitation of degraded wetlands in the mountain areas of Lesotho
8	Improvement of community food security through the promotion of food processing and preservation technologies
9	Strengthening and stabilizing eco-tourism based rural livelihoods
10	Promote wind, solar and biogas energy use as a supplement to hydropower energy
11	Stabilizing community livelihoods which are adversely affected by climate change through improvement of small scale industries

Source: UNFCCC website

In 2002 Malawi developed the “Poverty Reduction Strategy” aimed at reducing poverty through socio-economic and political empowerment of the poor (Ministry of Mines 2006). It is built around four pillars which include: (i) rapid sustainable pro-poor economic growth and structural transformation, (ii) human capital development, (iii) improving the quality of life of the most vulnerable, and (iv) good governance.

Through a consultative process involving public and private sector organizations, including NGOs and civil society, fifteen NAPAs options were identified from the eight sectors to address the urgent adaptation needs, with emphasis on most vulnerable rural communities and in tandem with the country’s Vision 2020. Some of the options are shown in Table 11. Urgent activities were combined into project clusters for the purposes of developing a short list of five project profiles. Each project profile contains a number of related adaptation activities, and identifies the required inputs, outputs, institutional arrangements and a proposed budget. The list of the proposed project profiles is as follows:

- Improving community resilience to climate change through the development of sustainable rural livelihoods,
- Restoring forests in the Upper and Lower Shire Valley’s catchments to reduce siltation and associated water flow problems,
- Improving agricultural production under erratic rains and changing climatic conditions,
- Improving Malawi’s preparedness to cope with droughts and floods, and
- Improving climate monitoring to enhance Malawi’s early warning capability and decision making and sustainable utilization of Lake Malawi and lakeshore areas resources.

These proposed projects represent Malawi’s “urgent and immediate” needs to assist vulnerable rural communities and other groups in targeted areas to adapt to the adverse impacts of climate change. Malawi will require US\$ 22.43 million to implement these priority projects.

Like other LLDCs, agriculture is the backbone of Uganda's economy as it contributes about 42% of GDP, over 90% of export earnings and employs over 80% of the labor force. Uganda has adopted NAPA and completed its preparation in 2007. To ensure implementation and coordination of NAPA projects and activities, Uganda founded the Climate Change Coordination Unit in 2009. The mandate of the unit is to ensure that climate change issues are integrated into the national budget, establish a strategy for communicating issues of climate change to the national community, adopt a training programme on climate change and embark on a public awareness campaign on climate change mitigation and adaptation strategies. NAPA preparation was guided by two considerations: the need for Uganda to achieve the Millennium Development Goals (MDGs) and the country's development objectives as enshrined in Poverty Eradication Action Plan (PEAP, 2004).

In Ethiopia, the government adopted the Climate Resilient Green Economy (CRGE) strategy which seeks to address the impact of climate change and improve the living standards of the people of Ethiopia. According to the Republic of Ethiopia (2011:9), the strategy to build a climate resilient green economy is four-pronged:

- Improving crop and livestock production practices to increase food yields, hence food security and farmer income, while reducing emissions
- Protecting and re-establishing forests for their economic and ecosystem services, including as carbon stocks
- Expanding electric power generation from renewable sources of energy fivefold over the next five years for markets at home and in neighbouring countries.
- Leapfrogging to modern and energy-efficient technologies in transport, industry and buildings.

Under the CRGE strategy, the government has introduced a range of adaptation initiatives with the view to reduce the country's vulnerability to the effects of climate change. The country has identified sectors which are more vulnerable to climate change and is giving them priority in as far as implementation of adaptive initiatives is concerned. These sectors are agriculture, water, health, buildings and transport. The country has also embarked on major forestation and reforestation initiatives and it has developed a range of adaptation activities to support natural ecosystems.

In 2002, Niger formulated its national policy on Poverty Reduction Strategy (PRS) and Rural Development Strategy (SDR) – articulating the strategic framework and policy actions towards sustainable development in the country. By 2006 the country completed its NAPA which was developed in alignment with the national development priorities as outlined in PRS and SDR. The NAPA adaptation measures match the orientations of the PRS and SDR with regards to food security, capacities building, water control, fight against desertification and the promotion of income-generating activities. A total of fourteen priority activities were identified as listed in Table 13.

Table 13. Niger's identified priority activities under NAPA

Order of priority	Activity description
1	Introducing fodder crop species in pastoral areas
2	Creating Livestock Food Banks
3	Restoring basins for crop irrigation
4	Diversifying and Intensifying crop irrigation
5	Promoting peri-urban market gardening and livestock farming
6	Promoting income-generating activities and developing mutual benefit societies
7	Water control
8	Producing and disseminating meteorological data
9	Creating Food Banks
10	Contributing to fight against climate-related diseases
11	Improving erosion control, water harvesting and conservation measures for agricultural, forestry and pastoral purpose
12	Dissemination of animal and crop species that are most adapted to climatic conditions
13	Watershed protection and rehabilitation of dam-off ponds
14	Building of material, technical and organizational capacities of rural producers.

Bolivia has adopted a model for rural development which seeks to promote and consolidate sustainable development in the country's rural areas via environmentally clean strategies such as conservation agriculture. It also seeks to promote those sectors which are productive and resilient to the impact of severe climate variability. In 2006/2007, the country implemented its National Climate Change Programme which places emphasis on techniques such as water efficiency, soil conservation, and small scale irrigation.

One of the ways in which states have sought to address the challenges of climate change and climate variability is through the establishment of national climate funds. In Asia, the Bhutan government adopted the Bhutan Trust Fund for Environmental Conservation (1996) whose aim is to ensure sustainable finance for the preservation of the country's forestry and biodiversity sectors which have been threatened by population growth and improper land use. The fund sought to achieve the following objectives

- Support in-situ and ex-situ conservation initiatives in the entire green sector, including sustainable utilization of genetic and species resources.
- Strengthening integrated conservation and development planning through conservation research and monitoring of biodiversity change, and
- Promoting conservation education and awareness of conservation policies and issues. (Namgyal 2005: 54)

Nepal introduced the Priority Framework for Action. This provides details on the country's ten year (2011-2020) intervention plan intended to build the capacity of the country to cope with the impacts of climate change and natural disasters in agriculture. It seeks to cover all the districts in Nepal which are vulnerable to extreme climate related events. Table 14 provides examples of some of the identified priority areas.

Table 14. Nepal's priority list of identified NAPA activities

Priority area		Cross-cutting priorities
1	Strengthen institutional and technical capacity for climate change adaptation and disaster risk management in agriculture and enhance policy frameworks and coordination mechanisms at all levels.	Capacity development
2	Assess and monitor climate risks (current and future) and vulnerabilities and enhance early warning systems for proactive climate risk management and adaptation to climate change.	
3	Improved knowledge management, database and awareness raising on climate change impacts, adaptation and disaster risk management.	Strategic partnerships among agencies
4	Reducing climate related risks and underlying vulnerabilities by implementing technical options by integrating approaches of Community Based Adaptation and Community Based Disaster Risk Management in agriculture and livestock sectors.	
5	Strengthen capacities and procedures for effective disaster preparedness, response and rehabilitation at all levels and integration of climate change adaptation into response, recovery and rehabilitation activities.	Knowledge and communication and gender equality

Source: Government of Nepal: Ministry of Agriculture and Cooperatives 2011.

Through decision 1/CP.16, the UNFCCC COP invited non-LDC developing country Parties to employ the modalities formulated to support the national adaptation plans (NAPs). Developing country Parties are also invited to plan, prioritize and implement adaptation actions, including projects and programmes, and actions identified in national and subnational adaptation plans and strategies, national communications, technology needs assessments and other relevant national planning documents. Mongolia adopted the National Climate Risk Management Strategy and Action Plan in 2009. It seeks to build the capacity of communities to resist the impacts of climate change through facilitating adaptation and reducing risk.

Armenia has adopted many adaptation activities intended to strengthen the country's capacity to cope with the effects of climate change. Table 15 below shows adaptation strategies that the country has adopted in order to strengthen the capacity of the agricultural sector to resist the effects of climate change.

Table 15. Vulnerability and adaptation measures for agriculture in Armenia

Vulnerability Criteria	Adaptation measures
Drop in yields of agricultural crops	• Breeding and introduction of drought resistant, dry resistant hybrids adapted to local conditions
Increase in loss of crop production because of hazardous hydro-meteorological phenomena	• Introduction of an insurance system • Development of anti-hail system • Implementation of anti-hail measures • Development of early warning and rapid response systems for hazardous hydro-meteorological phenomena
Increased level of morbidity among livestock	• Use of vaccinations
Drop in livestock sector productivity	• More widespread use of high mountainous pastures • Introduction of new livestock breeds
Decrease in the productivity of grasslands and pastures	• Reducing the per unit load of grasslands and pastures
Spread of agricultural crops diseases and Pests	• Introduction of crop species which are resistant to diseases
Reduced effective soil moisture and increased water demand	• Implementation of measures for improving moisture and characteristics of the soil
Decline in land fertility	• Application of crop rotation
Changes in the structure of crop lands and borders of agricultural lands	• Shifting the farming zone to areas with adequate moisture • Application of new irrigation technologies in arid areas considering changes in the surface water flow and atmospheric precipitation

Source: Armenia's Second National Communication to the UNFCCC, 2010.

A future which values the gifts of the earth depends on the transition to a greener, low-carbon economy supported by sustainable production and consumption. LLDCs are exploring ways to 'green' their economies by ensuring that they generate economic growth and invest in improvements in people's lives in ways consistent with sustainable development. For example, Rwanda adopted vision 2010 in which it seeks to steer the country to a green economy. The vision focuses on population, land management and the utilization of natural resources and a range of other socio-economic sectors. Vision 2020 is anchored on a number of pillars. One of the pillars is the protection and management of the environment. The country has so far adopted and implemented many initiatives which are intended to ensure the protection of ecosystems. For example, Rwanda has taken the initiative to preserve the Rwandan mountain gorilla and to restore wetlands in the Nyabarongo-Akagera network and Rungezi Complex. Efforts to preserve the critically endangered Gorilla beringei graueri (which is one of the rarest species of gorilla in the world) has resulted in the substantial generation of revenues through tourism. Apart from vision 2020, Rwanda has also adopted vision 2050 which seeks to transform the country to a developed climate resilient, low carbon economy by 2050. In the energy sector, Rwanda seeks to reduce the dependence on fossil fuel via the development of alternative sources of energy such as geothermal, methane gas and hydro.

In 2007, Rwanda completed its NAPA preparation and identified eleven priority options with such sectors as promoting "non rain-fed agriculture, integrated water resource management and early warning and information system" selected as the sectors demanding "urgent and immediate" action to address climate change.

The preparation of NAPAs across all LLDCs is a response to the call by UNFCCC to identify "urgent and immediate" priority adaptation needs aimed at minimizing the impacts of climate change while at the same time enhancing adaptive capacity of vulnerable communities that are most prone to the adverse effects of climate change. The common approach has been to: (i) identify a list of priority activities, (ii) formulate priority adaptation options, (iii) build capacity for adapting to longer-term climate change and variability, and (iv) raise public awareness on the urgency to adapt to the adverse effects of extreme weather events.

For LLDCs that are also LDCs, the preparation of NAPAs is complete and with technical assistance from LDC Expert Group (LEG) and UNFCCC secretariat, this has been a resounding success (Table 16). In addition, many countries have endeavoured to align their NAPAs with mainstream national development policy programs, e.g. poverty reduction strategy programs. To ensure ownership across the board, NAPA process adopted a participatory and integrated approach involving communities at grassroots level. This is important as it raises public awareness about climate change and its impact on vulnerable communities.

However, there are also notable challenges associated with NAPAs. First and foremost, all countries voiced the lack of human and institutional capacity to be able to successfully implement their NAPA activities; second, lack of financial resources was strongly indicated as the biggest challenge; for instance, Ethiopia indicated the largest budget of over US\$ 700 million that was required to implement its NAPAs, followed by Nepal (US\$ 350 million). In this regard, it's not clear what the national budget commitments are to finance the implementation of NAPAs. There is also fear that if NAPAs remain outside mainstream economy, they will die-off the moment the financial support from UN and other international stakeholders dries up. Third, many affected communities lack awareness about climate change and its impact, and in addition, there is no climate change and information data collection and data base management – all aspects that need attention.

Table 16. Successes and challenges associated with NAPAs by LLDCs that are LDCs

Item	Description
Successes	<ul style="list-style-type: none"> • NAPAs are overwhelmingly received and supported by LLDCs • Many have completed preparation of NAPAs • Most LLDCs have developed NAPAs in alignment with national development policy strategies • Because of community participatory outreach approach at grassroots level, NAPA preparation raised tremendous public awareness about climate change, land degradation and desertification • By allowing countries to take the lead in identifying priority activities, NAPAs are viewed as home-grown initiative with full government ownership and full citizen responsibility • NAPAs can be used to build synergies with programs of similar nature; e.g. NAPs, MEA, etc • the creation of LDCF as a special fund earmarked for NAPA preparation has had a big positive impact
Challenges	<ul style="list-style-type: none"> • Lack of human and institutional capacity to implement NAPA activities pose to derail the momentum • Insufficient financial resources to implement environmental activities could translate into very little achievement • No clear indications of budget commitment and planning by individual LLDCs • Lack of climate change data and information collection framework and data base management system • Inadequate understanding and awareness of climate change and its impacts by the vulnerable communities • Constraints in research and systematic observation systems • Non-inclusion of NAPAs in mainstream economy • Threat of too many projects under too many organizations duplicating roles and functions may “spoil the relish”

It is important to note that some LLDCs are faced with the challenges of preparing and implementing their NAPAs because they did not get assistance from institutions such as LEG. LEG's objective is to support least developed countries in the preparation and implementation of their NAPAs. This effectively means that only LLDCs which are least developed countries are eligible for support from LEG. There are many LLDCs which are not necessarily LDCs and these include Zimbabwe, Botswana, Swaziland, Tajikistan, Mongolia, and Kazakhstan. These countries are taking long to prepare as well as implement their NAPAs. The UNFCCC Adaptation Committee have made provisions for technical support to the non-LDCs and a number of financial support channels are available for non-LDC LLDCs for the NAP process, including under the GEF, and through bilateral and multilateral channels. The UNFCCC COP, in decision 12/CP.18, requested the Global Environment Facility (GEF), through the Special Climate Change Fund (SCCF), to consider how to enable activities for the preparation of the NAP process for interested developing country Parties that are not LDC Parties.

3.2 Regional intervention programmes on climate change

Regional integration, mitigation and adaptation strategies also play an essential role in assisting LLDCs to cope with the challenges of climate change and climate variability. In Africa, the African Development Bank (AfDB) is one of the major players in climate change interventions at the regional level. The bank developed the 2011-2015 Climate Change Action Plan which provides the basis for the implementation of the Climate Risk Management and Adaptation strategy (CRMA) and the Clean Energy Investment Framework (CEIF). These programmes seek to address the issues of adaptation and mitigation. Under the CCAP, the AfDB intends to invest US\$ 6.4 billion over the 5 year plan and continue to develop its support for climate resilient and low carbon development, especially in the areas of renewable energy, sustainable land and water use, sustainable transport and smart agriculture (AfDB 2012: 10). Table 17 provides a profile of some of AfDB's climate change programmes.

Table 17. Profile of AfDB climate change programmes

Climate resilient development	Low carbon development	Financing platform
Promoting sustainable land use and water resources management	Enhanced investments in Clean Energy and Energy Efficiency	Mobilizing concessionary resources
Building resilience of key infrastructure and urban systems	Promoting sustainable transport	Catalyzing private capital
Climate proofing of AfDB's Projects	Promoting sustainable land and forestry management	Maximizing market mechanisms

Source: AfDB, 2011

The African Water Facility (AWF) was established in 2004 to assist African countries to meet the growing investment need for the development as well as management of water resources in Africa. It was initiated by the African Ministers' Council on Water (AMCOW). The facility is funded by the AfDB, European Commission, Bill and Melinda Gates Foundation and other partners. The facility is a portfolio of many water-related projects which are targeted at the effective management of water resources in Africa. Its activities cover issues such as the management of national and trans-boundary water resources, the management of water resources information, water for agricultural use climate-resilient sanitation and water supply. Table 18 shows some of the projects implemented under this facility covering a number of LLDCs.

Table 18. Projects which were implemented under the African Water Facility

Beneficiary	Project name	Grant amount US\$	Amount disbursed US\$
Projects implemented in 2010			
Botswana	Improved agricultural water control and management Systems in Pandamatenga	1,169,000	870,000
Uganda	Roof catchment rainwater harvesting and and management in Uganda	449,830	449,830
Namibia	Development of an IWRM plan for Namibia	498,200	498,200
Uganda	Water supply and sanitation services for the urban Poor in Kagugube Parish-Kampala	800,000	800,000
Projects implemented in 2011			
Rwanda	Introduction of water harvesting techniques in Bugesera	450,000	
Ethiopia	Support to the development of water information and knowledge management systems	500,000	500,000
Burkina Faso	Capacity building for decentralized IWRM	540,000	300,000
Burkina Faso	Study of drainage and solid waste management systems Ouagadougou	642,000	354,000
Projects implemented in 2012			
Lesotho	Development of planning framework for rural water supply and sanitation	398,842	282,775
Zambia	Affordable and innovative irrigation systems for small scale farmers	719,191	391,821
Ethiopia	Use of solar and wind energy for rural water supply	1,991,880	298,782
Burundi/Rwanda	Bugesera trans-boundary IWRM development and conservation	770,000	374,200
Malawi	CCODE (NGO)-WSS and low income community Development	610,790	213,777
Multi-country	Strengthening water and environmental engineering Capacity	1,990,000	280,958

Source: African Water Facility website

The AWF has been instrumental in improving the governance of water resources in Africa. A significant number of LLDCs have benefited from the facility. However, there are some improvements which need to be done in order to maximize benefits for LLDCs. It is recommendable for the facility to initiate a specific facility which exclusively targets LLDCs. The Operational Effectiveness Assessment of the AWF (OEA 2010) came up with the following recommendations:

- Increased focus on supervision and support of project implementation thereby improving quality of projects and improved level of disbursement.
- Strengthen leadership and management capacities of the facility.
- The prioritization of projects and thematic areas should respond to African priorities and put particular focus on fragile states and those countries that are in greatest need for support.
- Strengthen AWF's monitoring and evaluation systems to improve communication of project outcomes and impact.

The Asian development Bank (ADB) has many initiatives intended to assist countries in the region including LLDCs to cope with climate change which are highlighted in Table 19.

Table 19. Profile of ADB climate change programmes

Mitigation	Adaptation
The Carbon Market Program – a financing scheme that supports the development of greenhouse gas mitigation projects (e.g. renewable energy, energy efficiency) in developing countries in Asia and the Pacific.	Initiative for Land Management aimed at restoring, maintaining, and enhancing the productive functions of land in Central Asia.
Cities Development Initiative for Asia to promote investment in urban infrastructure development in Developing Member Countries in Asia	Climate Change Adaptation for the Pacific Islands
The Energy for All Initiative – aimed at scaling up access to affordable, modern and clean energy among the region's poor.	"Water for All" for Asia and the Pacific
Clean Energy Program using the Clean Energy Financing Partnership Facility to increase regional energy efficiency in energy, transport and urban sectors; to adopt renewable energy sources.	Promoting Climate Change Adaptation in Asia and the Pacific
Sustainable Transport Initiative focused on creating transport systems that are accessible, safe, affordable, and environment-friendly.	Climate-proof road network

Source: ADB website

3.4 International support on Climate Change

International support on climate change is particularly essential for LLDCs as since majority of them do not command the capacity and resources to cope with its negative impact. The international community has been instrumental in mobilizing financial support to fund climate change-related activities. There are some multi-lateral funds for climate change that are established under the framework of the United Nations Framework Convention on Climate Change (UNFCCC) that include: the Adaptation Fund, Green Climate Fund, the Global Environment Facility (GEF), the Least Developed Countries' Fund and the Special Climate Fund.

The multilateral development banks also manage some Climate Investment Funds (CIFs) which were established in 2008. Bilateral finance for climate change is also a growing source of funds for financing climate change. For example, Japan through its Fast Start Finance, committed a total of US\$ 15 billion through bilateral and multilateral channels through 2012, as well as through direct projects with the private sector; Germany has the International Climate Initiative; the UK has established an International Climate Fund; Norway has the International Forest Climate Initiative and Australia has the International Forest Carbon Initiative.

This section reviews the interventions which have been supported in LLDCs by the international community.

The Adaptation Fund

The Adaptation Fund was established to finance concrete adaptation projects open to all developing countries including LLDCs that are parties to the Kyoto Protocol and are particularly vulnerable to the adverse effects of climate change. Over the past three years, the fund has dedicated about US\$ 200 million to increase climate resilience in 29 developing countries around the world, 3 of them LLDCs (Mongolia, Turkmenistan and Rwanda) accounting for close to 10% of the Fund. The Fund is financed through a 2% levy on the sale of emission credits from the Clean Development Mechanism and became operational in 2009.

Table 20. LLDC Projects funded under the Adaptation fund

Mongolia Project on ecosystem based adaptation approach to maintaining water security in critical water catchments	US\$5.5 million
Turkmenistan Project on addressing climate change risks to farming systems at national and community levels	US\$2.9million
Rwanda Project on increasing the adaptive capacity of natural systems and rural communities	US\$9.9million

Source: Adaptation fund website

The Global Environment Facility

The Global Environment Facility (GEF) serves as an operating entity of the financial mechanism of the UNFCCC. The GEF also serves as financial mechanism for the following conventions: Convention of Biological Diversity, Stockholm Convention on Persistent Organic Pollutants and UNCCD.

It was established in 1991 and has the longest track record on environmental funding. 39 countries pledged and deposited just over \$1 billion to the GEF during its fourth replenishment (2006 -2010) (GEF 4), most of which has been approved and disbursed to projects. 21 donor countries deposited \$889 million as part of the GEF's fifth replenishment (GEF 5) in 2010. GEF resources are allocated on the basis of a framework that considers the impact of dollars spent on environmental outcomes, but also ensures all developing countries including LLDCs a share of the funding. The facility seeks to address critical environmental focal areas such as biodiversity, climate change, land degradation, ozone depletion, international waters and persistent organic pollutants (Caverlier and Gray 2012).

Under GEF 4 a total of US\$2,909 million was allocated globally broken down as follows 31% to biodiversity, 31% to climate change, 9% to land degradation and 29% to other. Under GEF 5 a total of US\$3,815 million was allocated globally broken down as follows 32% to biodiversity, 36% to climate change, 11% to land degradation and 22% to other. Under GEF 5 a total of \$280 million was allocated to LLDCs, an increase of 7% from allocation under GEF 4. Compared to the global figure, the LLDC's were allocated 9% and 7% respectively for GEF 4 and GEF 5.

The Least Developed Countries Fund

The GEF also administers the Least Developed Countries Fund (LDCF) established under the UNFCCC to address the special needs of the LDCs (15 LLDCs included). The LDCF is tasked with financing the preparation and implementation of NAPAs. NAPA implementation projects under LDCF are designed entirely in accordance with the country's identified priorities and executed by national stakeholders, and involving active participation of vulnerable communities. Table 21 shows the LLDCs that have benefitted under the LDCF. In 2013, the fund has 19 donors: Australia, Austria, Canada, Denmark, Finland, France, Germany, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, and United Kingdom.

Of the 49 LDCs that had completed their NAPAs with support from the LDCF, 46 had accessed a total of \$628.15 million for 120 projects to address their urgent and immediate adaptation needs. As of October 31, 2013, cumulative pledges to the LDCF amounted to \$782.53 million, of which \$700.58 million had been received. (Source: GEF website).

Table 21. The LDCF for the preparation of NAPAs across LLDCs (2013)

Country	Project title	LDCF funding (\$mil)	Total Project Cost (\$mil)	% LDCF
Afghanistan	• Capacity building to climate change	6.039	20.548	0.29
Bhutan	• Enhance resilience to climate change • Address climate risk & local capacity	3.987 12.640	8.273 33.438	0.48 0.38
Burkina Faso	• Enhance adaptation to climate change • Reduce vulnerability to climate change • Strengthen early warning to climate change	3.300 7.700 4.400 4.191	23.445 29.107 28.705 23.661	0.14 0.27 0.15 0.18
Burundi	• Enhance risk management & adaptation • Community risk management	3.526 9.586	19.324 40.886	0.18 0.23
CAR	• Integrate adaptation to combat climate change on agriculture & food security	3.058	45.048	0.07
Ethiopia	• Enhance adaptation to climate change at community level	5.839	30.560	0.19
Lao PDR	• Improve resilience of agricultural sector to climate change • Disaster preparedness in changing climate	4.999 5.170	9.544 31.097	0.52 0.17
Lesotho	• Improve early warning to reduce impact of climate change • Enhance adaptation of small-scale agriculture production • Reduce vulnerability to climate change	1.735 4.330 9.196	4.456 17.330 35.396	0.39 0.25 0.26
Malawi	• Climate proofing • Strengthening climate information and early warning	5.850 4.400	35.850 11.857	0.16 0.37
Mali	• Enhance adaptive capacity • Integrate climate resilience in agriculture • Strengthen resilience through pastoral management • Strengthen resilience of women producers	2.400 2.400 2.390 6.006	6.600 6.975 12.060 22.506	0.36 0.34 0.20 0.27
Nepal	• Community-based flood risk reduction • Restoration of degraded forests and rangelands • Reduce vulnerability and increase adaptive capacity	6.930 5.744 2.945	27.283 17.218 12.192	0.25 0.33 0.24
Niger	• Build agricultural resilience to climate change • Scale up community-based adaptation • Integrate climate resilience into agriculture	3.960 4.125 4.180	15.020 17.375 19.380	0.26 0.24 0.22
Rwanda	• Reduce vulnerability to climate change via early warning and disaster preparedness • Build resilience of communities living in degraded forests and wetlands	3.999 6.022	16.427 16.767	0.24 0.36
Uganda	• Strengthen climate information and early warning systems	4.400	28.064	0.15
Zambia	• Adapt to effects of drought and climate change • Strengthen climate information and early warning systems	4.285 4.400	14.189 28.110	0.30 0.16

Source: GEF website

The distribution of LDCF across different sectors include: agriculture and food security which have received the largest share (31%), followed by water resource management (18%) and climate information services (15%).

The Special Climate Change Fund Trust Fund

The GEF also administers the Special Climate Change Fund (SCCF) that was established under the UNFCCC in 2001 to finance projects relating to: adaptation; technology transfer and capacity building; energy, transport, industry, agriculture, forestry and waste management; and economic diversification. The LLDCs that are not LDCs can access funds from the SCCF to help support preparation of their national adaptation plans and implement other climate change related activities. In 2013 the SCCF has approved 40 national projects on climate change totaling US\$140 million of which 9 are in LLDCs amounting to US\$23.8 million (see Table 22 for details).

Table 22. Allocation of SCCF Funds to LLDCs' projects on climate change USD

	Project Name	US\$
Zimbabwe	Scaling up adaptation in Zimbabwe, with a focus on rural livelihoods, by strengthening integrated planning systems	3,980,000
Tajikistan	Increasing climate resilience through drinking water rehabilitation in North Tajikistan	2,727,070
Ethiopia	Coping with drought and climate change	995,000
Zimbabwe	Coping with drought and climate change	983,000
Kyrgyz Republic	Promoting climate resiliency of water supplies in Kyrgyzstan	5,000,000
Mongolia	Mongolia livestock sector adaptation project	1,500,000
Azerbaijan	Integrating climate change risks into water and flood management by vulnerable mountainous communities in the greater caucasus region of Azerbaijan	2,700,000
Moldova	Climate resilience through conservation agriculture	4,260,000
Swaziland	To promote the implementation of national and transboundary integrated water resource management that is sustainable and equitable given expected climate change	1,670,000
	Total	23,815,070

Source: GEF Website

The UN-REDD program

The UN-REDD Programme is the United Nations Collaborative initiative on Reducing Emissions from Deforestation and Forest Degradation (REDD) in developing countries. The Programme was launched in September 2008 to assist developing countries prepare and implement national REDD+ strategies, and builds on the convening power and expertise of the Food and Agriculture Organization of the United Nations (FAO), the United Nations Development Programme (UNDP) and the United Nations Environment Programme (UNEP).

The Programme currently supports 44 partner countries spanning Africa, Asia-Pacific and Latin America, of which 16 are receiving support to National Programme activities. Of the 16 countries 3 are LLDCs: Bolivia, Paraguay, and Zambia. To-date, the UN-REDD Programme's Policy Board has approved a total of US\$67.3 million for National Programmes in these 16 partner countries. These funds help to support the development and implementation of national REDD+ strategies.

Green Climate Fund

The purpose of the Fund is to make a significant and ambitious contribution to the global efforts towards attaining the goals set by the international community to combat climate change in the UNFCCC. In the context of sustainable development, the Fund will promote the paradigm shift towards low-emission and climate-resilient development pathways by providing support to developing countries to limit or reduce their greenhouse gas emissions and to adapt to the impacts of climate change, taking into account the needs of those developing countries particularly vulnerable to the adverse effects of climate change.

The Fund will provide simplified and improved access to funding, including direct access, basing its activities on a country-driven approach and will encourage the involvement of relevant stakeholders, including vulnerable groups and addressing gender aspects. The Green Climate Fund was designated as an operating entity of the financial mechanism of the UNFCCC, in accordance with Article 11 of the Convention. The fund is still in its formative stage and it is early to look into its achievements. In 2009 developed countries committed to raising US\$100 billion a year by 2020 to help poorer countries cope with global warming.

The Energy and Environment Partnership

The Energy and Environment Partnership (EEP) program, funded by Finland, Australian Development Agency and the UK's Department of International Development, is a program that aims to promote renewable energy, energy efficiency and clean technology investment to developing countries, including LLDCs. The programme seeks to assist poor people with sustainable energy services while combating climate change. Some LLDCs which include Botswana, Swaziland, Rwanda, Lesotho, Uganda, and Zambia are beneficiaries of this programme. A majority of households in these countries depend on traditional energy such as firewood and in worst cases cow dung.

The Climate Investment Funds

The funds are administered by the World Bank in partnership with regional development banks including the African Development Bank (AfDB), the Asian Development Bank (ADB), the European Bank for Reconstruction and Development (EBRD), and the Inter-American Development Bank (IDB). This fund is two-pronged. It composes of a 5 billion to 6 billion dollars Clean Technology Fund which finances scaled-up demonstration, deployment and transfer of clean technologies by providing investments in those countries or regions with high potential for greenhouse gas abatement. There are 15 Clean Technology Fund country investment plans including 1 from an LLDC – Kazakhstan, and 1 regional plan.

The Climate investment funds also consists of the Strategic Climate Fund which finances three programs which are the Pilot Programme for Climate Resilience, the Forest Investment Programme, and the Scaling up Renewable Energy for Low Income Countries (SREP). The Pilot Programme for Climate Resilience (PPCR) funds technical assistance and investments to support countries' efforts to integrate climate risk and resilience into core development planning and implementation. There are 19 PPCR pilot countries including 5 LLDCs (Bolivia, Nepal, Niger, Tajikistan and Zambia) and 2 regional pilots. The Forest Investment Programme (FIP) supports developing country efforts to reduce deforestation and forest degradation and promote sustainable forest management that leads to emissions reductions and enhancement of forest carbon stocks (REDD+). There are 8 FIP pilot countries including 2 LLDCs (Laos and Burkina Faso).

The SREP was established to scale up renewable energy solutions and expand renewables' markets in the poorest countries. SREP financing supports a range of technologies such as solar, wind, bio-energy, geothermal and hydro-technologies. The SREP is being implemented in 10 pilot countries including 4 LLDCs Armenia, Ethiopia, Mali, Nepal. The annual disbursements of the Climate investment funds are shown in Table 23.

Table 23. Annual Disbursements of Climate investment Funds US\$ Million

Fiscal year	Clean Technology Fund	Pilot Programme for Climate Resilience (PPCR)	Forest Investment Programme	SREP
2011	6.1	0	0	0
2012	179	3.8	0	2.5
2013	470	33.7	8.9	5.1

Source: Climate Investment Funds Website

The International Climate Fund

UK has developed the International Climate Fund whose objective is to assist developing countries to mitigate and adapt to climate change, reduce carbon emissions and to reduce poverty. According to Department for International Development (2011) priority areas include: Helping the poorest people to adapt to the effects of climate change on their lives and livelihoods; Protect millions of poor people from droughts, floods and other extreme weather events; Help millions of poor people to secure access to clean energy; Work with the private sector to invest in low carbon development; Helping poor countries develop in ways that avoid or reduce harmful greenhouse gas emissions and enabling millions of people to benefit from clean energy; Build a global partnership between developing and developed countries to combat illegal logging and Protecting the world's forests and the lives of the 1.2 billion who depend on them.

Nepal is one of the LLDCs benefiting from this fund. In partnership with the European Commission, UK is funding the Nepal Climate Change Support Programme (NCCSP) whose objective is to help communities to build the capacity to resist the effects

of climate change. It is envisaged that by 2015, the programme would have been extended to 3 million beneficiaries comprising the country's poorest and most vulnerable people (DFID; 2012). The UK is also supporting the Nepal Multi-Stakeholder Forestry Programme whose objective is to help local institutions and the forestry industry to promote the sustainable management of forests in adapting to climate change.

The Global Climate Change Alliance

The Global Climate Change Alliance (GCCA) was founded in 2007 by the European Union with the view to consolidate cooperation and dialogue on climate change with developing countries most vulnerable to climate change, in particular LDCs and Small Island Developing States (SIDS). It provides financial and technical support to developing countries in order to assist them to mainstream climate change into their national development plans and budgets. The GCCA has five priority areas which are: mainstreaming climate change into poverty reduction and development efforts; adapting to climate change; reducing emissions from deforestation and forest degradation; enhancing participation in the global carbon market and disaster risk management (European Union; 2011).

These initiatives have been implemented in a number of LLDCs that are LDCs including Bhutan, Ethiopia and Nepal. An overview of GCCA priority programmes, budgets and project duration in some LLDCs is shown in Tables 24.

Table 24. Overview of GCCA national programs in LLDCs

Country	GCCA priority areas	Budget (Euros)	Duration
Bhutan	Mainstreaming	Total value: 4.40 million (GCCA including 0.8 million fast start funding from Estonia)	2012-2016
Ethiopia	Mainstreaming and adaptation; CDM	Total value: 13.7 million (GCCA, including 8 million EC fast start funding)	2011-2015
Mali	REDD	Total value: 6.215 million (GCCA: 5.65 million and Government of Mali 0.565 million)	2010-2016
Nepal	Mainstreaming and Adaptation	Total value: 19.4 million (GCCA 8.6 million including 0.6 million fast start funding from Cyprus and DFID: 10.8 million)	2011-2014
Rwanda	Adaptation	Total value: 4.555 million (GCCA)	2010-2012
Uganda	Mainstreaming and Adaptation	Total value: 11 million (GCCA fast start funding from Ireland)	2012-2016

Source: GCCA website

3.5 National Action Programmes (NAPs) to combat desertification and land degradation

The United Nations Convention for Combating Desertification (UNCCD) came into force in 1996, and today it's the centrepiece organization galvanizing effort around the globe involving coordinating, facilitating implementing and monitoring action programs and strategies aimed at tackling desertification and land degradation problems. According to ECA (2007), the fundamental objective of UNCCD is to "combat desertification and mitigate the effects of drought in countries experiencing serious drought and/or desertification." All LLDCs countries are contracting parties to the convention and many of these countries are engaged in various activities and at various stages in meeting their obligations. The discussion below looks at some of these activities at national, regional and international level.

Many LLDCs with support from development partners are at different stages in developing and implementing their National Action Programmes (NAPs) to combat desertification and land degradation. Since inception, the guiding principle is outlined in Agenda 21 of the Convention which requires "effective participation of the local, national or regional level of non-governmental organizations and local populations, both women and men, particularly resource users, including farmers and pastoralists and their representative organizations in policy planning, decision-making and implementation and review of National Action Programs".

Various countries are at different stages in the implementation of NAPs. For instance, in Niger, one of the LLDCs in the Sahel region of Africa, a number of projects as indicated in Table 25 are being carried out within the framework of the country's National Action Plan to Fight Desertification and Manage Natural Resources, which was adopted in December 2000.

Table 25. Implementation of NAPs: Case of Niger

The 'African Land and Water Initiative', for which the 2004-2005 pilot project was financed with 515,000 dollars obtained from the World Bank and under the UNCCD.
The 'Natural Forests Management Project', financed with about 15.6 million dollars from the AfDB and UNCCD during 2000-2005.
An institution-building project to support the National Action Plan to Fight Desertification and Manage Natural Resources, financed by Italy with 1,600 dollars during 2002-2004.
A presidential initiative that seeks to encourage community participation on the part of the youth and fight poverty, carried out during 2001-2004. It was financed with some 70 million dollars from the Heavily Indebted Poor Countries Initiative (HIPC).
The 'Community Action Programme', also a poverty reduction initiative, financed by the World Bank and the GEF with 39 million dollars for 2004 to 2008.
The 'National Forestry Programme', financed with 365, 900 dollars from the United Nations Food and Agriculture Organization, 2004-2006.
A project to fight silting up of the Niger River watershed, financed by the AfDB and the Niger Basin Authority, with about 9.6 million dollars for 2004-2008.

Source: Adapted from Inter Press Service News Agency 57 (in ECA, 2007)

However across many LLDCs, limited progress has been achieved in implementing the NAPs. As observed by the report of the UNCCD Secretariat: *"while most of the countries of the region have had national action programmes (NAPs) for several years, meaningful progress has not been made with their operational implementation."* Nkonya et al discuss some of the challenges as well as successes pertaining to NAPs and these are summarized in Table 3.15. Perhaps the greatest success associated with NAPs is its bottom-up approach which encourages participation of local communities at grassroots level as well as raising awareness concerning the problems of DLDD. Thus NAPs empower communities by allowing them to take charge of DLDD problems affecting their communities. But despite this success NAPs have faced challenges and key amongst them is limited implementation due to lack of financial capacity as evidenced by limited government commitment to implement NAPs. Another challenge is that NAPs are viewed under "project-mode" as well as "donor-driven" window, with the main goal being to meet donor expectations and not necessarily country's policies and priorities. In addition, unlike sister program like national adaptation plans to climate change, the NAP is predominantly identified with developing countries and not with developed or middle income countries as there is no existence of NAP in these countries (Nkonya et al, 2011). Further there has been limited mainstreaming of NAPs in national policy programs.

National desertification funds and National Coordinating Bodies (NCBs)

In a laudable move, some countries have set up the National Desertification Funds (NDFs) as part of the NAP process. The NDFs serve as local and easily accessible sources of funding for implementation of NAP priorities. However countries are encountering difficulties in making these funds available and genuinely operational. This can be attributed partly to the existence at national level of similar or related funds – implying duplication of roles.

In accordance with the provisions of UNCCD, countries in the region are establishing National Coordinating Bodies (NCBs). The NCBs are mainly charged with the role of coordination, guidance and leadership in order to ensure cross-sectoral and integrated planning for desertification control activities (ECA, 2007). However country reports highlight that NCBs are ineffective as they are constrained by the limited human, technical and financial resources at their disposal.

Table 26. Successes and challenges associated with NAPs by LLDCs

Item	Description
Successes	<ul style="list-style-type: none"> • NAPs have been implemented based on bottom-up approach which seeks to empower local communities • NAPs have created greater awareness and consciousness among the affected communities about severity of desertification and land degradation in LLDCs • NAPs have helped galvanize global effort to combat land degradation and desertification • Most LLDCs have developed NAPAs in alignment with national development policy strategies • NAPs can be used to build synergies with programs of similar nature especially NAPAs
Challenges	<ul style="list-style-type: none"> • Actual implementation of NAPs has been minimal due to lack of human capacity and financial resource commitments • Many LLDCs have channeled low volume of resources towards NAP activities • NAPs have been largely donor-funded and tend not to be integrated into mainstream national policy programs • No clear indications of national budget commitment

Source: Nkonya et al (2011)

The LLDCs have also implemented specific measures to address desertification and land degradation which are presented below.

Sustainable land use management

Sustainable integrated land and water management are key solution to prevention of desertification and land degradation prevention. Efforts are being made in LLDCs to promote sustainable land use management. Good management practices include measures which aim to spread and reduce the pressures of human activities using rotational use, appropriate stock-ing rates matched to the carrying capacity of ecosystems, and diverse species composition (MA, 2005). Table 27 provides the various types of land degradation, possible solution and potential impact. For instance, zero tillage can result in 30-40 per cent reduction in labor costs and 50 per cent increase in gross margin compared to hand-plowing (Haggblade and Tembo, 2003 cited in Nkonya et al, 2011).

To preserve soil productivity, sustainable long-term practices must be applied. UNCCD Best Practice approaches focus on (Kirby and landmark, 2008):

- Sustainable Land Management (SLM) technologies, including adaptation;
- capacity-building and awareness-raising at various levels;
- desertification, land degradation and drought, and SLM monitoring and assessment /research;
- knowledge management and decision support;
- the policy, legislative and institutional framework;
- funding and resource mobilization; and
- participation, collaboration and networking.

Table 27. Types of land degradation, solution and potential impact

Type of land degradation	Solution	Potential impact and profitability*
Water induced soil erosion	<ul style="list-style-type: none"> • Mechanical methods: soil and water conservation structures; drainage structures • agronomic management methods: mulching; crop management; planting pattern • soil management methods: minimum tillage or no tillage; ridge tillage 	<ul style="list-style-type: none"> • standing crop residues are 5-10 time more effective in controlling wind erosion than flattened crop residue
Water-induced soil erosion	<ul style="list-style-type: none"> • windbreak and dune stabilization using trees and other vegetation cover • no till rotational grazing to improve land cover 	
Salinity	<ul style="list-style-type: none"> • prevention of salinity • amelioration using intermittent or continuous leaching • breeding for saline-resistant crop varieties 	
Compaction/crusting	<ul style="list-style-type: none"> • soil management methods: periodic deep tillage, controlled farm equipment or livestock traffic, conservation tillage • agronomic methods: intercropping or rotational cropping alternating shallow-root and deep-root crops 	<ul style="list-style-type: none"> • No tillage can save 30-40% of labor • gross margin of minimum tillage can be 50% more than plowing using hand-hoe
Loss of biodiversity	<ul style="list-style-type: none"> • prevention of land use conversion that lead to biodiversity loss • afforestation and reforestation programs • promotion of diversified cropping and livestock systems 	
Soil fertility mining	<ul style="list-style-type: none"> • integrated soil fertility management (ISFM) 	<ul style="list-style-type: none"> • ISFM is more profitable than use of fertilizer or organic soil fertility alone
Soil pollution	<ul style="list-style-type: none"> • reduced use of agrochemicals • integrated pest management (IPM) • proper use of agrochemicals 	<ul style="list-style-type: none"> • IPM is more profitable than conventional plant protection
Overgrazing	<ul style="list-style-type: none"> • rotational infrastructure • drought resistant crop varieties • mulching and other carbon-sequestering management practices 	<ul style="list-style-type: none"> • compared to continuous grazing rotational grazing can increase live weight up to 30% in the Sahel region
Drought	<ul style="list-style-type: none"> • development of irrigation infrastructure • drought resistant crop varieties • mulching and other carbon-sequestering management practices 	

Source: Nkonya et al. 2011

*Empirical evidence cited in various source

Increase population resilience

One valuable way of reversing land degradation is to reduce people's vulnerability by increasing the availability of alternative livelihoods and strengthening their resilience. Promoting agricultural risk management insurance schemes that target smallholder farmers can help offer the necessary risk protection tools while at the same time providing incentive to adopt high risk but high return technology. A number of countries (Malawi, Ethiopia, Mali, etc) are piloting weather index insurance schemes in Africa with a view to increase people's resilience to catastrophic climate events particularly drought (Makaudze, 2012).

One good example is Mongolia which started an index-based livestock insurance in 2005. It's a financial insurance scheme offered to pastoralists in Mongolia's drylands. It covers herds of livestock against natural hazards including catastrophic risks posed by extreme winter weather. A basic commercial insurance policy is sold by insurance companies that pay out when livestock mortality exceed a certain level. However should the mortality rate exceeds a predetermined maximum, then the government compensates all herders regardless of whether they bought insurance or not. This means the largest losses are transferred to the government using a public safety net program (Mahul and Skees, 2007 in Makaudze 2012).

Other programs that can increase people's resilience include land reform as this can play a major part in improving people's ability to cope. But this must be accompanied by a land tenure security system that guarantees land rights use and land transfer

and land tradability. A leasehold forestry project in Nepal is achieving valuable results. Supporting science-driven agriculture is essential, as it enables farmers to take advantage of up-to-date developments and best practice which has worked elsewhere. Rainwater harvesting, drought resistant crop varieties, agro-forestry and efficient energy use, all can contribute to sustainable land management and improve ways of managing drought risk. Further, it is well understood that dryland areas are overpopulated and therefore unable to support human and livestock populations. One of the main keys is to reduce the dependence on these lands via creating jobs or pursuing livelihood types not dependent on land cultivation, or tillage (Kirby and Landmark 2008:19). Beyond these approaches, there is much more that can be done, for instance partnership building for sustainable investments. This would involve: institutional strengthening at local level; governance empowerment and capacity development; and targeting women and youth.

Improve land management

To address land degradation it is necessary to restore and fertilize the land. Essential nutrients such as nitrogen, phosphorus, calcium, magnesium etc. must be replenished in order for plants to grow. After the soil has lost all or part of its nutrients, which may also involve the accumulation of toxic elements such as salt, it is degraded and its productivity diminishes as a consequence. Intensive agriculture is one of the main reasons for soil degradation, and once this has occurred it is necessary to re-establish soil fertility by using either synthetic fertilizers or natural compost. The restructuring and revitalizing of the soil is an effective and sustainable way to maintain soil fertility.

Diversify production

Greater diversity in agricultural ecosystems leads to healthier and more sustainable production and nutrition, an important consideration for producers whose consumption is largely drawn from own production. More needs to be done, especially at the farm level, to build local capacities to conserve and use genetic biodiversity (FAO, 2012). Mixed farming reduces the loss of agricultural products in the case of a natural disaster, and certain production methods are obviously better adapted to counter drought than others. In many cases prolonged monoculture cultivation system repeated on the same plot of land must be avoided. Instead a system of rotational crop production is necessary in assisting the soil to restore and/or regain its fertility.

Diversified rotations, including crop varieties and species with different thermal/temperature requirements, better water use efficiency and resistance to pest/disease, and lower yield variability are an effective way to reduce risks and increase efficiency (Lipper et al 2010). Introducing new types of crops (such as vegetables), trees (fruit and wood products) and other plants can increase and diversify production and improve overall nutritional levels.

Integrated crop and livestock systems can also be exploited so as to enhance the efficiency and environmental sustainability of production systems. For instance, while animal manure can increase crop production, crop residues and by-products on the other hand can be used as animal feeds. Such systems can provide opportunities for increasing overall production and economic resilience of farmers.

Restore land

To reclaim degraded lands, crop techniques should be improved by stabilizing the soil while enriching it with organic matter. Improved irrigation efficiency can transform unproductive soils back to a productive state. It is important to overcome marked soil salinity by employing the most effective systems of irrigation. This involves removing any surplus water, monitoring the changes in groundwater reserves and soil salinity in the problem areas, draining, irrigating and planting trees whose roots will prevent soil erosion.

Investing in climate-smart agriculture

Climate-smart agriculture is a new practice that is increasingly gaining global attention as an innovative approach to addressing challenges of climate change and food security. According to (Moreau et al, 2012) climate-smart agriculture is defined as “agriculture-based practices that have the potential” to sustainably achieve food security through enhanced agricultural productivity without depleting water and soil resources; increase farmers’ and farming systems’ resilience to climatic change and improve capacity of systems to sequester carbon and mitigate climate change. A distinct advantage associated with climate-smart agriculture is its potential to attain a “triple win” which include sustainable increase in productivity; adaptation built on resilience and contribution to greenhouse gas mitigation.

Conservation agriculture is an example of climate-smart agriculture. It is a farming practice based on three key characteristics: minimal mechanical soil disturbance as it involves no tillage; maintenance of a mulch of carbon-rich organic matter covering and feeding the soil; and rotations or sequences of crops including trees which could include nitrogen-fixing legumes. In essence conservation agriculture provides the essential climate change adaptation and mitigation solutions while improving food security through sustainable production and enhanced productivity of resource (Lipper et al, 2010).

Uzbekistan is one of the few LLDCs experimenting with conservation agriculture. With assistance of FAO, the country is improving mono-cropping of cotton through conservation agriculture including zero-tillage, diversification (rotation with wheat and grain legumes) and selected cover crops. Some demonstration plots have been established and training in soil water dynamics, organic matter improvement and related soil stability measures has been offered. The results have been encouraging as farmers have demonstrated willingness to adopt conservation agriculture practices with well-tested crop rotation system.

Farmers in Lesotho have managed to boost agricultural yields and increase food production by adopting conservation agriculture (Lipper et al, 2010). The practice, locally known as "likoti", has also proven essential in combating soil erosion and enhancing fertility. This has helped poor households particularly in rural communities to rehabilitate and strengthen their livelihoods and ultimately building strong resilience in the face of widespread poverty and increasing vulnerability affecting the country. Results show that those farmers who attend training are more likely to adopt likoti. Further, other important determinants include the level of education and economic incentives provided to vulnerable households (Lipper et al, 2010).

Agroforestry is another example of climate-smart agriculture. It is a practice that involves the use of trees and shrubs in agricultural crop and/or animal production and land management systems. Trees on farms are particularly prevalent in Southeast Asia and Central and South America. Agroforestry practices come in many forms such as improved fallows, home gardens, growing multipurpose trees and shrubs, boundary planting, farm woodlots, orchards, plantation/crop combinations, shelterbelts, windbreaks, conservation hedges, fodder banks, live fences, trees on pasture and tree apiculture (Nair, 1993 and Sinclair, 1999 in Lipper et al, 2010).

Water harvesting provides another example of climate-smart agriculture. Improved water harvesting techniques and water-use efficiency (irrigation systems) are fundamental for increasing production and reducing uncertainty and irregularity of rainfall patterns caused by climate change. If there is intensified irrigation especially in LLDCs in Africa this can generate 130percent more yields than rain-fed systems (Lipper et al, 2010). The expansion of efficient management technologies, especially those relevant to smallholders is fundamental in addressing climate change, land degradation, desertification and drought in LLDCs.

Burkina Faso is one the LLDCs that has experimented with water harvesting techniques. For instance, in Yatenga province, farmers have succeeded in reclaiming degraded farmland by digging planting pits, known as zai (Lipper et al, 2010). This traditional technique involves increasing depth and diameter of the pits and adding organic matter. The Zai improves nutrients concentration and facilitates water infiltration and retention. Thus land which used to be barely productive has now been transformed into productive land capable of achieving yields ranging from 300kg/ha to 1500kg/ha, depending on rainfall. In the same province, with support from Oxfam, farmers have begun building stone contour bunds to harvest rainwater. This practice allows water to be spread evenly throughout the field and infiltrate the soil. It also prevents soil and organic matter from being washed away. Because of wide networks of farmers these techniques are practiced on over 200,000ha (Reij 2009, in FAO, 2010).

3.6 Regional Programmes on desertification and land degradation

Development and Implementation of Sub-regional Action Programmes (SRAPs) and the Regional Action Programme (RAP) on desertification.

Subregional Action Programmes (SRAP) and the Regional Action Programme (RAP) on drought and desertification have been developed and undertaken by countries within specific regions. In essence these programs complement the NAPs particularly with respect to trans-boundary resources such as lakes, rivers, forests; and crosscutting issues including information collection and dissemination, capacity building and technology transfer. In Africa, Five SRAPs have been put in place which include the Permanent Inter-State Committee on Drought Control in the Sahel (CILSS) and the Economic Community of West African States

(ECOWAS) for West Africa and Chad subregion; the Arab Maghreb Union (AMU) for the AMU sub-region; the Southern African Development Community (SADC) for the Southern Africa subregion; and the Intergovernmental Authority on Development (IGAD) for the Eastern Africa subregion.

Under the auspices of the Regional Coordination Unit (RCU) hosted by the AfDB, a RAP has been initiated and is based on six Thematic Programme Networks including: Integrated management of international river, lake and hydro-geological basins; Promotion of agro-forestry and soil conservation; Rational use of rangelands and promotion of fodder crops development; Ecological monitoring, natural resources mapping, remote sensing and early warning systems; Promotion of new and renewable energy sources and technologies; and Promotion of sustainable agricultural farming systems. The RCU plays a critical role including the exchange of information on combating desertification between regional and global level.

In 2003 the landlocked developing Sahel countries of Burkina Faso, Chad, and Niger benefited from the pilot project: Operation Acacia, implemented under the auspices of FAO with financial support from the Italian government. The project, hailed as one of the classically successful project, has helped local farmers to restore degraded land by planting native Acacias that produce gums and resins – popular products for people in the Sahel region. Other positive impacts of the project include (ECA, 2007) the training of about 56 000 producers of gum Arabic and resin and the restoration of more than 13 000 hectares of degraded.

Various programs have been implemented at sub-regional level. For Instance the *NEPAD Environment Initiative (EI)* which includes combating desertification as one of its priority program has been developed by UNEP. UNEP also works closely with sub-regional organizations including CILSS, IGAD, Sahara and Sahel Observatory (OSS), SADC, UMA, and ECOWAS, to finalize sub-regional action plans for the NEPAD Environment Initiative. Ethiopia is being assisted by UNEP to develop its national action plans for the NEPAD EI on a pilot basis. If successful this will provide key lessons for further implementation in other countries in Africa.

The Green Wall for the Sahara Initiative, a program initiated by the African Union (AU) in collaboration with ECA, FAO, UNEP and UNCCD is another example showcasing a subregional action program. It covers a wide group of countries, including Mali, Niger, Chad, Ethiopia, and Burkina Faso, among others. The main goals of the programme are: to slow the advance of the Sahara Desert, enhance environmental sustainability, control land degradation promote integrated natural resources management, conserve biological diversity, contribute to poverty reduction, and create jobs (ECA, 2007:29).

The Sahara and Sahel Observatory has initiated the need to establish a long-term Ecological Monitoring and Observatory Network. The network covers 12 affected countries in the Sahara/Sahel subregion and it gathers environmental data for use by decision makers. This initiative has seen 11 countries operate and gather high quality information on the evolution of natural resources and the effectiveness of management systems.

The need for up-to-date information on land degradation continues to receive serious attention. In this regard GEF funded the Land Degradation Assessment (LADA) project, a global initiative implemented by UNEP and executed by FAO with support of the UNCCD, the Global Mechanism and the International Soil Reference and Information Centre. Once successful the LADA project will be scaled-up to produce important statistics on Global Land Degradation Assessment. This will allow Parties to the UNCCD to have an overview of the status of land degradation and to identify the areas where intervention may be needed to stop and/or reverse land degradation.

Comprehensive Africa Agricultural Development Program (CAADP)

Comprehensive Africa Agricultural Development Program (CAADP), launched in 2003 under the umbrella of NEPAD, is a regional program that envisions an African continent built on strong sustainable agricultural developmental pathway free of hunger/starvation, poverty and food insecurity. CAADP hinges on four commonly identified pillars/objectives which include: improve land and water resource management (pillar 1), improve rural infrastructure, market access and trade capacities (pillar 2), enhance food security and improve disaster risk management (pillar 3) and improve agricultural research and extension system (pillar 4).

In addition, included under CAADP are specific goals/targets set to guide country strategies and stir investment programs which are: (i) to achieve a 6% average annual growth rate target for the agricultural sector at national level; (ii) to allocate 10% of national budget to the agriculture, (iii) the exploitation of regional complementarities and cooperation to boost growth, and (iv) the principle of partnerships and alliances to include farmers, agribusiness and civil society communities. A number of African LLDCs are parties to the CAADP initiative.

3.7 International Support to combat desertification

At the international level, most of the interventions have come via bilateral and multilateral funding arrangements. These funding arrangements have proven very crucial in financing implementation of the UNCCD and SLM related initiatives across the globe. Among the programs and activities funded are: programs on community based natural resources management, agricultural development, integrated water resources management, livelihood and rural development as well as programs specifically targeted at policy reform, institutional capacity development, research and monitoring, and information management. Among the main bilateral and multilateral funding sources include: Japan International Cooperation Agency (JICA), European Union (EU), Finnish Department for International Development Agency (FINIDA), Danish International Development Agency (DANIDA), United States Agency for International Development (USAID), German Technical Cooperation Agency (GTZ), the African Development Bank (AfDB), Norwegian Agency for Development Cooperation (NORAD), Canadian International Development Agency (CIDA), United Kingdom Department for International Development (DFID), the World Bank and the French Development Agency. Financial and technical support from NGOs and civil society organizations has also proven crucial.

TerrAfrica is an African Union-led program present in 24 countries (of which 12 are LLDCs) on the continent that supports innovative solutions to sustain landscapes, address land and water degradation and adapt to a changing climate. The programme was launched in 2005 and works to improve coordination between the governments of Sub-Saharan Africa, the international development community and other global and regional partners including NEPAD, regional and sub-regional organizations, the UNCCD Secretariat, the UNCCD Global Mechanism (GM), GEF, IFAD, FAO, UNDP, UNEP, AfDB as well as multilateral organizations including the European Commission, bilateral donors, civil society and scientific organizations including FARA and CGIAR centers. *TerrAfrica* and its partners are assisting countries in developing their Country Sustainable Land Management Investment frameworks.

UNCCD GM and UNCCD Secretariat programs have played a pivotal role in mobilizing technical and financial support as highlighted by many country reports. The UNCCD GM operating under Article 21 of the UNCCD, is mandated to “increase the effectiveness and efficiency of existing financial mechanisms to promote actions leading to the mobilization and channelling of substantial financial resources to affected developing country Parties.” At country level the GM focuses on providing support needed to “mainstream NAPs and other SLM priorities into national policies, strategies and budgeting processes; enhancing partnerships between Government and its development partners with a view of establishing country-level financing partnerships; and supporting investment programming - as part of the strategy to catalyze resource mobilization to support local initiatives” (ECA 2007:39). At sub regional level, GM focuses on policy dialogue, enhancing coordination of UNCCD activities, and strengthening the capacity of partner institutions. Some of the achievements of the GM catalytic funds include the following:

- In West Africa, USD 110,000 in GM catalytic resources have enabled Niger and Nigeria, with support from UNEP, to develop a trans-boundary natural resources management project which received a USD 10 million grant from the GEF; and
- In Burkina Faso, a GM catalytic support of USD 130,000 facilitated the incorporation of the main activities of this country's NAP into the Poverty Reduction Strategy, leading to the mobilization of approximately USD 175 million relating to desertification control.

The Asian Development Bank (ADB) has played a major role in funding anti-dust and sandstorm projects. Dust and sandstorms are natural phenomena that have occurred for thousands of years in Northeast Asia. For the past 50 years, the frequency has increased, geographic coverage has expanded, and damage intensity has accelerated. Hence in order to cope with such serious environmental problem, the ADB, the United Nations Economic and Social Commission for Asia and the Pacific (UNESCAP), the UNCCD and UNEP are working jointly on a project that aims for “Prevention and Control of Dust and Sandstorms in Northeast Asia”.

International finance institutions and renewable energy development

International financial institutions have mobilized substantial resources of more than \$30 billion committed towards UN's initiative “Sustainable Energy for All”. Programs such as “Lighting Africa”, being financed by the World Bank, aim to provide lighting to more than 70 million low-income households by 2020. Regional development banks such AfDB are also playing their part in promoting renewable sources of energy. The AfDB plans to invest \$20 billion in renewable energy development by 2030. It also intends to raise additional \$80 billion through forging partnerships with public and private enterprises. The AfDB will also promote regional energy projects that benefit multiple countries as well as increasing electricity in rural regions including its “Sustainable Energy Fund for Africa.”

Some individual countries are also playing a role in supporting energy development particularly in Africa. For instance Norway has committed about \$140 million over five years to help scale up access to sustainable energy in rural areas of Ethiopia.

One important intergovernmental organisation set up in 2009 to promote renewable energy is the International Renewable Energy Agency (IRENA), located in Abu Dhabi. It supports countries in their transition to a sustainable energy future, and serves as the principal platform for international cooperation, a centre of excellence, and a repository of policy, technology, resource and financial knowledge on renewable energy. IRENA promotes the widespread adoption and sustainable use of all forms of renewable energy, including bioenergy, geothermal, hydropower, ocean, solar and wind energy in the pursuit of sustainable development, energy access, energy security and low-carbon economic growth and prosperity. IRENA encourages governments to adopt enabling policies for renewable energy investments, provides practical tools and policy advice to accelerate renewable energy deployment, and facilitates knowledge sharing and technology transfer to provide clean, sustainable energy for the world's growing population. The Abu Dhabi Fund for Development has made available US\$350 million in support of innovative renewable energy projects under IRENA.

3.8 Summary

This section has highlighted the interventions and support measures to address climate change, desertification and land degradation at national, regional and international levels. The LLDCs have developed national adaptation plans for addressing climate change and national action plans for addressing desertification. As discussed more resources are required to enable the LLDCs to fully implement their plans.

4.1 Lessons learnt

The following lessons have been drawn from existing relevant literature and the foregoing analysis.

4.1.1 Climate change, desertification and land degradation are among the most severe constraints affecting landlocked countries – important to reduce their vulnerability

While all countries worldwide are negatively impacted by climate change, land degradation and desertification, it is the LLDCs which are hardest hit for various reasons – lack of human capital, low adaptive capacity, economically disadvantaged, undiversified agro-based economies, etc. Because most LLDCs are located in drylands best described as arid, semi-arid and hyper-arid regions (e.g. Sahel, Central Asia) many are extremely vulnerable to climate change, desertification and land degradation. With climate change projections predicting increases in temperatures, high frequency and intensity of extreme drought events this is likely to worsen aridity conditions predominant in dryland ecosystems. This leaves the already fragile ecosystems more barren and exposed to wind erosion, soil erosion and runoff losses – all factors that create ideal conditions for exacerbation of land degradation and desertification in LLDCs.

4.1.2 The principle of participatory ‘bottom-up approach’ has proven successful under both national adaptation plans to address climate change and national action plans to address desertification and land degradation

All national adaptation plans and national action plans have built-in genuine participation and involvement of local people at grassroots level including farmers, pastoralists and their representative organizations. The approach emphasizes that people who bear the brunt of the climate change, desertification and land degradation and who best understand the fragile environment in which they live must be fully involved and be allowed to participate in the decisions that will shape their lives. This view of shared ownership and responsibility in policy planning, decision-making and implementation holds the key to the success of national adaptation plans and national action plans in many LLDCs.

4.1.3 Drawing on knowledge of local people and tapping local resources has proven to be the most effective approach to tackling desertification and land degradation in LLDCs

People living in dryland areas of most LLDCs are the greatest asset as they know their land better than anyone else. In some way their skills may be greater, for they have to work in far more difficult conditions, with much more fragile soils, much harsher climate and far fewer resources. They are potentially the world’s most important asset in combating desertification. The ‘operation Acacia’, proves a case in point. The project, drawing on local knowledge and tapping the well known and well-adapted Acacia tree, is hailed as one of the classically successful projects in the Sahel. It has helped local farmers to restore degraded land by planting native Acacias that produce gums and resins.

4.1.4 Risks posed by extreme climate change related events particularly extreme floods, cyclone and droughts constitute the most formidable threats to LLDCs economies

Catastrophic climate events, particularly droughts and floods, pose the most formidable threats to LLDCs. Experience and lessons learnt have shown how vulnerable LLDCs are to extreme climate events. Coupled with lack of well-established disaster risk management programs such as early warning mechanisms, insurance and re-insurance schemes etc, most LLDCs depend on goodwill of regional and international community whenever an extreme event strikes. There is a real danger that extreme events fuelled by climate change can cause massive destruction to LLDCs yet little attention has been devoted to disaster risk hedging programs at national and international level.

4.1.5 Strengthen early warning systems in LLDCs

It is critical that national and regional early warning systems be strengthened across LLDCs. There is a need to revamp early warning mechanism across many LLDCs where they are either poorly developed or non-existent. A good example is the absence of desertification early warning system across many LLDCs despite its potential significance. As strongly observed in Millennium Ecosystem Assessment (2005) report, understanding the significance of desertification is seriously hampered by lack of information. Information gathering enables development of a baseline and indicators of desertification and land degradation. Such information helps raise awareness with policymakers regarding the severity of desertification and land degradation. Use of satellite-based remote sensing or aerial photographs with ground-based observations can provide consistent, repeatable, cost-effective data on vegetation cover. Drylands, where most LLDCs are located, have advantage in the sense that they are mostly cloud-free and hence a wide range of images are available.

4.1.6 Addressing land degradation can positively impact soil carbon storage and help protect biodiversity across LLDCs

Deforestation converts forests into carbon dioxide, reduces the vegetation's carbon-storage capacity and reduces the water-holding capacity of the soil, thus inducing land degradation. Hence, a programme for sustainable land management, including forests and agriculture, will limit global warming and conserve some biodiversity. New approaches such as conservation agriculture, precision farming, zero tillage practices, etc, all can yield positive outcomes that promote soil carbon storage, improve soil structure and fertility. Such practices promote sustainable land management and in turn, improve the livelihoods of those communities dependent on the land.

4.1.7 Share among LLDCs and other developing countries success stories and best practices to address climate change, desertification and land degradation

The sharing of knowledge amongst LLDCs provides an ideal platform to learn from one another and exchange ideas especially on best practices to combat climate change, desertification and land degradation and achieve sustainable development. Sustainable agriculture must be promoted through best practices, climate-smart agriculture and new conservation-oriented technologies, including mitigation through carbon sequestration and adaptation. Science and policy advocacy must contribute to the dissemination of successful innovation, supportive land management and effective best practices.

4.1.8 Addressing climate change, land degradation, desertification and drought across LLDCs by building synergies between UNFCCC, UNCCD and CBD

If land degradation is not seriously addressed, up to 70 per cent of the mitigation obtainable from protecting forests would be lost. The challenges of meeting costs of land degradation, desertification and drought are compounded by the ecological and economic changes associated with climate change and biodiversity loss. Unabated effects of land degradation diminish biodiversity both above the ground and within the soil, and this diversity underpins the ecosystem services that benefit society. Land degradation also contributes to global climate change by releasing to the atmosphere carbon stored in vegetation and soils. Unless suitable changes are made to their use of those resources, poor people can be forced to engage more into unsustainable land uses, inflicting further land degradation damages.

Improved land management and rehabilitation, the cornerstone of the UNCCD national action programmes (NAPs), can be re-energized. By strongly linking the UNCCD NAPs with the UNFCCC national adaptation programmes of action (NAPAs), the necessary bridges between development and adaptation initiatives can be built, notably in the drylands.

4.2 Policy gaps – what LLDCs ought to do

The UNCCD stipulates specific requirements to be undertaken by the affected country parties which include the following: (a) give due priority to combating desertification and mitigating the effects of drought and allocate adequate resources in accordance with their circumstances and capabilities; (b) establish strategies and priorities within the framework of sustainable development plans and/or policies, to combat desertification and mitigate the effects of drought; (c) address the underlying causes of desertification and pay special attention to the socio-economic factors contributing to desertification processes; (d) promote awareness and facilitate the participation of local populations, particularly women and youth, with the support of non-governmental organizations, in efforts to combat desertification and mitigate the effects of drought and (e) provide an enabling environment by strengthening as appropriate, relevant existing legislation and where they do not exist, enabling new laws and establishing long-term policies and action programs. These issues are briefly discussed below:

4.2.1 Give due priority to combat desertification and mitigate the effects of drought and allocate adequate resources to NAPs in accordance with their circumstances and capabilities

One way to prioritize these challenges is to allocate national budgets under NAPs specifically earmarked to fight against desertification, land degradation and drought at national level. The National Desertification Fund (NDF) is a good approach in this direction, however it falls short as not many LLDCs have shown such commitments. Some countries have encountered difficulties in making these funds available and genuinely operational. In other countries this is attributed partly to the existence at national level of similar or related funds – implying duplication of roles.

4.2.2 Establish strategies and priorities within the framework of sustainable development plans and/or policies, to combat desertification and mitigate the effects of drought.

Not many LLDCs have established their own strategies and priorities to combat desertification, land degradation and drought, outside the UNCCD global effort. Drought for example, despite its long history and disastrous consequences, many LLDCs (and LDCs) continue to treat and operate it under emergency status. Such emergency operations are bound to crash particularly at nation-wide scale. Not many countries have mainstreamed drought, desertification and land degradation so that they are part and parcel of national development strategies.

4.2.3 Address the underlying causes of desertification by paying special attention to the socio-economic factors contributing to desertification and land degradation

Without alternative forms of livelihoods particularly in rural areas, poor people are forced to over-exploit land resources to the fullest extent including encroachment on fragile lands for survival. Unless poverty is seriously addressed, the fight against desertification and land degradation will be a lost battle. Alternative livelihoods that provide diversified income-generating opportunities can help reduce the pressure on land and ecosystems and alleviate poverty need to be accorded priority. Promoting sustainable renewable energy (e.g. solar and wind power) affordable to the poor in LLDCs provides a long-term solution that will see less pressure exerted on natural resources leading to reduction in deforestation, land degradation and desertification.

4.3.4 Promote awareness about land use suitability and best SLM involving the participation of local populations, particularly women and youth, in an effort to combat desertification and mitigate the effects of drought

One driving force behind land degradation is putting land to use for which it is not suitable, a common problem across many LLDCs. This is not only due to excessive pressure on land resources but perhaps more importantly, due to ignorance about the consequences of faulty land use. Adoption of land use according to land capability classes, to the extent possible, will ensure that land is put under the right kind of use. The land users need to be educated about the consequences of bad land cultivation practices. Because of the absence of a well-defined land use policy for the LLDCs, land management has been unsystematic, arbitrary and, by no means sustainable. The importance of a national policy frame, in this context, can hardly be over-emphasised.

4.2.5 There is need to mainstream national adaptation plans for climate change and national action plans for desertification in national development programs with clear budget commitment

Because of the profound impact of climate change, land degradation and desertification on the economies of LLDCs, it is difficult to see how LLDCs can develop without mainstreaming these challenges into their development priorities, policies and programs. While some LLDCs have endeavoured to merge the national adaptation plans with mainstream national policy programs, other countries need to follow suit. In addition for both national adaptation plans and national action plans, there is no clear national budget commitment by LLDCs. Issues related to climate change, land degradation and desertification are often limited to government ministries and agencies which deal with the environment. These are cross-cutting issues which should be integrated into the entire development framework of LLDCs.

4.3 New emerging opportunities

4.3.1 New global policy initiative –Land Degradation Neutral world

Land degradation continues to be under increasing spotlight with the recent agreement by world leaders at UNCSD (Rio+20) to strive to achieve a land degradation neutral world being a further step in the right direction. This global initiative, which though ambitious, aims at attaining a 'land-degraded neutral world'. Land degradation remains pervasive in all ecosystems, with disproportionate impact on drylands, LLDCs home to many of the world's poorest and most vulnerable people. The call by world leaders to strive to achieve a land degradation neutral world (LDNW) serves a dual purpose; first, it's a call to prevent the degradation of productive land and second, it's a call to restore land that is already degraded.

4.3.2 Zero Hunger Challenge initiative – 100 percent food secure world

The Zero Hunger Challenge is a new vision recently launched at Rio+20. A future free from hunger envisions a world where everyone enjoys the right to adequate food, women are empowered, food systems are sustainable and resilient, support to family farming is increased, poverty is reduced through agriculture and rural development and good nutrition is assured for pregnant women. It is an invitation to all stakeholders to take action towards achieving zero hunger or 100% food security. Given LLDCs contain a subset of the poorest countries in the world facing acute food insecurity this call should find special resonance with this group of countries.

4.3.3 There is a need to develop a stronger early warning system for monitoring desertification based on remote sensing and satellite technology

The need to develop strong indicators for monitoring desertification and land degradation based on satellite technology is not new. In 1987 the World Commission on Environment and Development suggested that land use in agriculture and forestry should be based on a scientific assessment of land capacity and monitoring of the annual depletion of topsoil. These issues received further attention in the JPoI and WSSD. The UNCCD suggests the adoption of two mandatory impact indicators: land cover status and the proportion of the population living below the poverty line. Strengthening the scientific base of the UNCCD on land degradation, desertification and drought issues is an important prerequisite to meeting the new LDNW policy.

Various indicators have been suggested and recently the Committee on Science and Technology, recommended the provisional use of a set of eleven impact indicators that closely match the goals of UNCCD. Two of the eleven measures are mandatory and similar to those mentioned above. Though the indicators are not exhaustive, they provide an important starting point for capturing the necessary data essential for monitoring the conditions of the populations and ecosystems affected by desertification. This indicator-based monitoring approach is expected, over time, to lead to simple, verifiable, measurable, and comparable information for the reporting process.

Other proposed indicator systems include four aspects:

- *Pressure indicators* – characterize driving forces both natural and man-made, affecting the status of natural resources and leading to desertification. They can be used to assess desertification trends and for early warning.
- *State indicators* – characterize the status of natural resources including land.
- *Desertification impact indicators* – can be used to evaluate the effects of desertification on human beings and environment.
- *Implementation indicators* – can be used to assess the actions taken for combating desertification and to assess its impacts on natural resources and human beings.

5.1 Conclusion

This study established that climate change, land degradation and desertification are seriously impacting the development prospects of many LLDCs. Following the APoA (2003), the international community is increasingly becoming aware of the developmental difficulties being faced by LLDCs as a result of climate change, desertification and land degradation. Unless bold steps and strategies are undertaken to address these challenges, LLDCs will suffer unprecedented economic losses and continue to languish in vicious cycle of un-development, and under-development characterized by poverty, food insecurity, malnutrition, high mortality, and etc. As a result, these challenges will see many countries failing to achieve the Millennium Development Goals.

Drawing on lessons learnt, policy gaps and new opportunities, the study identifies a number of priorities and recommendations aimed at building the resilience of LLDCs to climate change, desertification and land degradation. Major policy interventions at national, regional and international level are required to mitigate and reverse the impact of climate change, desertification and land degradation in LLDCs. Assessment of future scenarios (MA, 2005) shows that major interventions and shifts in ecosystem management will be needed to overcome challenges related to desertification and land degradation. More importantly reversing desertification and land degradation facilitates eradication of extreme poverty and hunger, as envisioned in the MDGs. Hence in conclusion, addressing climate change, desertification and land degradation in LLDCs is critical and essential to help these countries meet their internationally agreed development goals.

5.2 Priorities and Recommendations

Based on the findings made in this study, the following specific recommendations are proposed for the development of LLDCs:

Priority 1: Strengthening National Plans

Strengthening of the development and implementation of National Plans

Several LLDCs have developed and are implementing national adaptation plans for climate change and national action plans to fight desertification and manage natural resources. However, it is clear that considerably more efforts are required along with added capacity building and technology transfer in order to meet the needs to successfully develop and implement the plans. Greater emphasis ought to be placed on developing the plans in a holistic way and incorporating climate change and desertification into development priorities at the national and regional levels. Additional resources, earmarked to address climate change desertification issues, are required from the international community.

Priority 2: Agriculture and food security

Encourage investment in climate-smart agriculture in LLDCs

Climate-smart agriculture is a new practice that is increasingly gaining global attention as an innovative approach to addressing challenges of climate change and food security. It is defined as “agriculture-based practices that have the potential” to sustainably achieve food security through enhanced agricultural productivity without depleting water and soil resources; increase farmers’ and farming systems’ resilience to climatic change and improve capacity of systems to sequester carbon and mitigate climate change.

Conservation agriculture is an example of climate-smart agriculture which involves: minimal mechanical soil disturbance as it involves no tillage; maintenance of a mulch of carbon-rich organic matter covering and feeding the soil; and rotations or sequences of crops including trees which could include nitrogen-fixing legumes. In essence conservation agriculture provides the essential climate change adaptation and mitigation solutions while improving food security through sustainable production and enhanced productivity of resource. There are other adaptive methods (agroforestry, water harvesting, etc) that have already proved to be effective— these needs to be replicated or scaled up. It is recommended that the UN leads international efforts in crafting a special comprehensive climate-smart smallholder agricultural concrete plan of action targeting LLDCs with a well-defined set of goals and objectives.

Strive to diversify the economic base of LLDCs

LLDCs continue to rely heavily on a single or in some cases just a few primary export commodities and hence they are highly vulnerable to climate change, desertification or external shocks. There is a need to assist LLDCs to build a strong diversified economic base that is resilient to absorb economic shocks and capable to produce a range of value-added goods which are competitive on the world market. The international community should play a decisive role in assisting the LLDCs to build diversified economies. In this regard, it is recommended that UN offers specialized assistance directed at assisting LLDCs develop highly unique niche areas for which they are well-endowed and command comparative advantage. For instance, special assistance could be offered to support LLDCs' mountainous ecosystems establish commercial forest trees of high medicinal, pharmaceutical or cosmetic value or cut-flower production – all with high export value.

Promote regional and sub-regional integration among LLDCs

Regional integration, cooperation and collaboration among LLDCs themselves is very essential in prioritising needs, facilitate policy dialogue and establish common ground in tackling common challenges such as climate change, desertification and land degradation affecting their economies. This can be achieved through, inter alia, the establishment of firm multilateral and bilateral pacts and the development of regional modern climate-proof road and rail infrastructure and regional water resource management. It is recommended that regional integration among LLDCs could prove more effective in tackling problems of climate change, desertification and land degradation.

Priority 3: Water security

Because most of LLDCs are located in dryland areas (including hyper-arid, arid and semi-arid) water scarcity imposes a severe constraint

Water scarcity will impose severe constraints on the development prospects and aspirations of many LLDCs. The threat of fresh water scarcity due to climate change is much greater in drylands (than in non-drylands system) where LLDCs are predominantly located. 60 per cent of the population in LLDCs are located in drylands compared to only 32.2 per cent in transit developing countries; these countries face greatest threat to climate change, desertification and land degradation. Freshwater availability in drylands is projected to decrease from the current overall average of 1,300 cubic meters per person per year to well below the lowest threshold of 2,000 cubic meters required for human well-being and sustainable development.

Priority 4: Renewable energy development

Promote sustainable energy development with a focus on renewable energy

Energy plays a pivotal role in the development discourse of LLDCs. Currently a majority of the people in LLDCs are rural based and largely dependent on traditional biomass for cooking and heating purposes. This has exerted immense pressure on forest resources leading to extensive deforestation, land degradation and desertification. The international community needs to help LLDCs ensure that the poor people in rural areas have access to modern energy services which are affordable, efficient, sustainable and renewable. This is one of the major ways not only of addressing climate change, land degradation and desertification but of reducing poverty. It is recommended that special programs that target accelerated provision and development of 'sustainable energy for all' in rural areas' deserves high priority with solid national and international support.

Priority 5: Disaster risk reduction and early warning systems

Establish 'climate disaster insurance facility' fund for LLDCs

There tends to be a fragmented approach with no single well-coordinated fund to cover or protect LLDCs against extreme catastrophic events. Extreme climate events such as floods, droughts, cyclones, etc can cause massive destruction to property, infrastructure such as roads, bridges, rails, telecommunication and etc in a way that can overshadow the commendable progress so far achieved in LLDCs. Despite the escalating losses associated with these events most LLDCs have yet to find effective ways of reducing and managing the risks they pose. For instance, economic losses due to floods in South Asia are in absolute terms far smaller than those in the OECD. Relative to the size of LLDCs South Asia's GDP, however, flood losses are approximately 15 times greater than losses in the OECD. Thus, although economic loss risk in the OECD may be increasing faster, such losses threaten OECD countries' economies far less than they do those of most LLDCs. Larger economies tend to be more diverse geographically and economically, and are thus better able to compensate for losses in any one region or sector. LLDCs have least capacity to absorb and recover from drought or flood-inflicted economic losses. UNCCD can lead the effort in the establishment of such a global comprehensive climate insurance funding facility especially for LLDCs with the financial support of international partners. It is therefore recommended that the international community helps establish a special climate disaster insurance fund that target LLDCs as they are extremely vulnerable to extreme climate events.

The Bali Action Plan (2007) calls for "consideration of risk sharing and transfer mechanism, such as insurance" as a means to address losses in developing countries due to climate change. Article 4.8 of the UNFCCC allows room for insurance to be included as a tool to combat the impacts of climate change. Catastrophic disaster insurance is one of the few specific policy instruments for adaptation that can be considered as a special provision for LLDCs. A leaf can be taken from the Caribbean countries which established a common "disaster risk management fund" as a regional collective response to the challenges posed by extreme climate events (typhoons, hurricanes, tsunamis, etc).

Strengthen early warning systems

Using remote sensing and satellite technology can boost early warning systems in LLDCs. They are capable of providing rapid and effective detection of hazards such as wildfires, deforestation, drought, floods, changes in water levels, and natural hazards. With rapid advances in data collection, analysis, visualization and dissemination, including technologies such as Geographical Information Systems (GIS), telecommunications and internet, it is now feasible to deliver relevant information on a regular basis and reach wider audience relatively inexpensively.

It is critical that national and regional early warning systems be strengthened across LLDCs. For instance Southern African Regional Climate Outlook Forum (SARCOF) is regional organization that has interactively worked with national meteorological departments within SADC region in monitoring ENSO signals and issuing seasonal climate forecasts. Despite their potential, forecasts have been of minimal impact for a number of reasons: they are poorly communicated; too wide and unrealistic; difficult to understand the probabilistic undertones; broadcasted too late and etc. In short there is a need to revamp early warning mechanism across many LLDCs where either poorly developed or non-existent. The absence of early warning systems that monitor desertification and deforestation on long term basis across many LLDCs in a way that informs policy makers should be very disturbing. It is recommended that national and regional early warning systems must receive high priority as climate change mitigation tools.

Priority 6: Information system and research

Raise public awareness and access to information

LLDCs are among the countries with the least awareness of issues of climate change, land degradation and desertification. This is exacerbated by the majority view that these countries are the most vulnerable and have the least adaptation capacity. In fact, a low level of awareness undermines the country's capacity to adapt and mitigate these factors. The struggle against climate change, land degradation and desertification cannot be won without ensuring the awareness of communities regarding not only impacts of these factors on socio-economic development of the LLDCs but also the projected impacts. UNFCCC underscores the essence of public awareness and encourages, inter alia, the need to adopt educational public awareness programmes with the view to inform the public on climate change and its consequences.

A majority of the people who are hardest hit by the impacts of these factors have little or no understanding of their impacts. It is difficult for such populations to adopt the best practices as far as mitigation and adaptation are concerned. Public access to information encourages mass participation in national mitigation and adaptation strategies. It is therefore essential for LLDCs to establish awareness programmes which target specific stakeholders.

Establish strong links with research think-tanks

There is little and in most cases fragmented information regarding effects of climate change on LLDCs. Research plays an important role in informing LLDCs on the degree and scope of the effects of climate change, land degradation and desertification on their economies and the livelihoods of their populations. This research information can be used for policy formulation and deciding the best practices which LLDCs should adopt in order for them to cope with a changing climate. Currently there is dearth of think tanks in LLDCs which can carry out consistent, reliable and cutting-edge research into these issues. It is also essential for the international community, particularly the UN, to establish international centres of excellence whose purpose is to conduct such studies.

It is important to note that the research and interventions on climate change, land degradation and desertification is dominated by governments. There is little participation of private institutions, particularly the civil society in LLDCs. The civil society can play an essential role, particularly in the fields of research, advocacy and information dissemination. It is essential for the international community to assist in the establishment of research and development institutions in LLDCs which will play a titanic role in conducting research on climate change, land degradation and desertification. These institutions can be helpful in identifying the special needs, priorities and interests of LLDCs within the context of their national circumstances. For instance, the development of indices for monitoring and evaluation of desertification and land degradation processes within LLDCs could be conducted via academic research centres.

Priority 7: Capacity building

Institutional and human capacity building

Generally, LLDCs have poor human and institutional capability to deal with the causes and effects of climate change, desertification and land degradation. LLDCs are characterized by weak capacities, institutions and adaptation and mitigation policies and practices. Mitigation and adaptation should be firmly embedded into the development policies and programmes of LLDCs. Different countries have different national circumstances, needs and priorities. There is need for LLDCs to strengthen their institutional capabilities in order for them to be able to identify best initiatives to combat climate change, desertification and land degradation that best suit their circumstances, priorities and interests. The Institutions of LLDCs should have the capacity to conduct cutting-edge research which will enable the countries to develop a set of vulnerability indicators which can be used to develop an early warning framework.

In order to be effective, the fight against climate change, land degradation and desertification needs to involve a multiplicity of actors and institutions. Mitigation and adaptation priorities and programmes are largely monopolized by government ministries and agents. It is important for LLDCs to seriously consider the role of non-state actors, especially the private sector and Non-governmental organizations not only in formulating the best practices but also in the implementation of these practices. These actors, including universities, are capable of conducting cutting-edge research and proffer viable and effective adaptation and mitigation mechanisms.

One of the major institutional challenges in the mitigation and adaptation strategies in LLDCs is the poor coordination of these activities. There is need therefore to strengthen the coordination capacity of institutions and also to ensure that measures of ensuring transparency and accountability in the management and implementation of strategies are in place.

What should be included in the post 2015 development agenda?

This study has demonstrated at length how climate change, land degradation and desertification are negatively impacting the economies of LLDCs. In mapping future development agenda, climate change, desertification and land degradation challenges must be accorded high priority. Thus, drawing from the list of identified priorities (discussed above), the following issues deserve more priority in post 2015 development agenda:

- Promote water resource management and development so as achieve national water security
Water is the most “vulnerable and endangered resource” across most LLDCs due to climate change, desertification and land degradation. Water resources affect all spheres of the economy – health, food production and security, domestic consumption, energy and industry and environment. As illustrated in the study, because many LLDCs are geographically located in dryland regions, water availability and accessibility will impose a heavy bearing on future development of many LLDCs. Unlike the current MDGs, clearly defined benchmarks and targets to be achieved must be defined for water. For instance indicators that reflect water footprint or consumption/utilization underpinning national water security are the essential common measures required to denominate achievements across countries.
- Promote, monitor and evaluate “land use and land cover” based on an objective set of indicators
It is important to emphasize that a well-developed indicator system must be put in place to allow continuous real time measurement of climate change, desertification and land degradation not only across LLDCs but entire globe. The next phase of the development agenda must therefore be based on an internationally acceptable code of objective indicators such as climate change vulnerability index, desertification index, land degradation index, etc. This will not only ease monitoring and evaluation of land use and land cover activities but also help to systematically generate crucial statistics necessary to alert and/or inform policymakers. For example, human development index (HDI) is not only a universally accepted yardstick but also a common statistical benchmark necessary to assess the level of progress (or lack of) in terms of human development across nations.
- Promote disaster risk reduction and resilience strategies
Unlike the original MDGs, disaster risk reduction strategies and resilience need to receive special attention and priority in post-2015 development agenda. Reducing the impact of climate change through prevention, preparedness, early warning and promoting insurance and commodity exchange markets can help LLDCs avoid huge economic losses.
- Promote accelerated development of “sustainable renewable energy”
The battle on desertification and land degradation is won (or lost) based on the development of the energy sector. The UN motto “Sustainable energy for all” is a noble approach that must be explicitly incorporated in the next agenda and crafted in a similar way like MDG 1 and could read as follows: “halve the number of people without access to sustainable energy by 20XX.”
- Accelerate the achievement of the Zero hunger initiative
If re-interpreted the zero hunger initiative is simply an extension of MDG 1 which calls for a 100 percent food secure world. Given LLDCs contain a subset of the poorest countries in the world facing acute food insecurity this call should find special resonance with this group of countries.

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Appendix A. GDP economic growth rate in LLDCs for the period 1990-2012

Region	LLDC	GDP annual growth (%)											
		1990	1992	1994	1996	1998	2000	2002	2004	2006	2008	2010	2012
Southern Africa	Botswana	6.8	2.9	3.6	5.6	10.6	5.9	9.0	6.0	5.1	3.7	8.1	6.1
	Lesotho	5.6	7.3	5.3	5.2	1.7	5.1	0.5	2.3	4.3	5.7	7.9	4.0
	Malawi	5.7	-7.3	-10.2	7.3	3.9	1.6	1.7	4.9	2.1	8.3	6.5	1.9
	Swaziland	21.0	3.2	2.4	3.8	2.6	1.8	1.8	2.9	3.3	2.4	1.9	-1.5
	Zambia	-0.5	-1.7	-8.6	6.9	-1.9	3.5	3.3	5.4	6.2	6.0	7.6	7.3
	Zimbabwe	7.0	-9.0	9.2	10.4	2.9	-3.1	-8.9	-5.8	-3.5	-17.7	9.6	5.0
	Average	7.6	-0.8	0.3	6.5	3.3	2.5	1.2	2.6	2.9	1.4	6.9	3.8
East Africa	Burundi	3.5	1.0	-3.8	-8.0	4.8	-0.9	4.4	4.8	5.4	5.0	3.8	4.0
	Ethiopia	2.7	-8.7	3.2	12.4	-3.5	6.1	1.5	13.6	10.8	10.8	9.9	8.5
	Uganda	6.5	3.4	6.4	9.1	4.9	3.1	8.7	6.8	10.8	8.7	5.9	3.4
	Average	4.2	-1.4	1.9	4.5	2.1	2.8	4.9	8.4	9.0	8.2	6.5	5.3
Sahel	Burkina Faso	-0.6	0.2	1.3	11.0	7.3	1.9	5.1	4.5	6.8	5.8	7.9	10.0
	CAR	-2.1	-6.4	4.9	-4.0	4.7	-2.5	-0.6	1.0	3.8	2.0	3.3	4.1
	Chad	-4.2	8.0	10.1	2.2	7.0	-0.9	8.5	3.4	0.2	-0.4	13.0	5.0
	Mali	-1.9	8.3	0.9	3.2	6.0	3.2	4.2	2.2	8.6	5.0	5.8	-1.2
	Niger	-1.3	-6.5	4.0	3.4	10.4	-1.4	3.0	0.1	5.8	9.6	-8.0	11.2
	Average	-2.0	0.7	4.3	3.2	7.1	0.1	4.0	4.3	5.0	4.4	4.4	5.8
East Asia	Bhutan	10.9	4.6	5.0	5.6	5.9	6.9	10.7	5.9	6.8	4.7	11.7	9.4
	LAO PDR	6.7	5.6	8.2	6.9	4.0	5.8	5.9	6.4	8.6	7.8	8.5	8.2
	Mongolia	-3.2	-9.3	2.1	2.2	3.3	1.2	4.7	10.6	8.6	8.9	6.4	12.3
	Nepal	4.6	4.1	8.2	5.3	3.0	6.2	0.1	4.7	3.4	6.1	4.8	4.6
	Average	4.8	1.3	5.9	5.0	4.1	5.0	5.4	6.9	6.8	6.9	7.8	8.6
West Asia	Afghanistan	-	-	-	-	-	-	-	1.1	5.6	3.6	8.4	-
	Armenia	-	-41.8	5.4	5.9	7.3	5.9	13.2	10.5	13.2	6.9	2.1	7.1
	Kazakhstan	-	-5.3	-12.6	0.5	-1.9	9.8	9.8	9.6	10.7	3.3	7.3	5.0
	Kyrgyzstan	5.7	-13.9	-20.1	7.1	2.1	5.4	0.0	7.0	3.1	8.4	-0.5	-0.9
	Tajikistan	-0.6	-29.0	-21.3	-16.7	5.3	8.3	10.8	10.3	7.0	8.0	6.5	8.0
	Turkmenistan	35.4	-15.0	-17.3	6.7	7.1	5.5	0.3	5.0	11.0	14.7	9.2	11.1
	Uzbekistan	1.6	-11.2	-5.2	1.7	4.3	3.8	4.0	7.7	7.3	9.0	8.5	8.2
	Average	10.5	-19.4	-11.8	0.9	4.0	6.4	6.3	7.3	8.3	7.7	5.9	6.4
South America	Bolivia	4.6	1.6	4.7	4.4	5.0	2.5	2.5	4.2	4.8	6.1	4.1	5.2
	Paraguay	4.1	1.7	5.3	1.6	0.1	-2.3	0.0	4.1	4.8	6.4	13.1	-1.2
	Average	4.4	1.7	5.0	3.0	2.5	0.1	1.2	4.1	4.8	6.3	8.6	2.0
Eastern Europe	Moldova	-	-6.6	-1.8	1.2	3.4	4.6	0.9	4.6	5.0	5.0	2.9	-0.3
	Macedonia	-2.4	-29.1	-30.9	-5.3	-6.5	2.1	7.8	7.4	4.8	7.8	7.1	-0.8
	Average	-2.4	-17.8	-16.3	-2.0	-1.6	3.3	4.3	6.0	4.9	6.4	5.0	-0.5

Source: UNEP Geo Data

Appendix B: Agriculture contribution to GDP in LLDCs (1990 – 2011)

Region	LLDC	Agriculture contribution to GDP (%)					
		1990	1995	2000	2005	2010	2011
Southern Africa	Botswana	4.9	4.4	2.7	1.8	-	-
	Lesotho	24.7	18.0	11.9	9.0	9.8	8.8
	Malawi	45.0	30.4	39.5	32.6	30.1	30.2
	Swaziland	10.4	12.0	12.2	8.8	7.9	7.5
	Zambia	20.6	18.4	22.2	22.8	20.4	19.5
	Zimbabwe	16.5	15.2	18.3	18.6	17.8	15.7
	Average	20.3	16.4	17.8	15.6	19.5	16.3
East Africa	Burundi	55.9	48.1	43.9	44.5	35.1	34.7
	Ethiopia	54.3	57.5	49.9	46.7	46.7	46.4
	Uganda	56.6	49.4	29.4	26.7	24.2	23.4
	Rwanda	32.5	44.0	37.2	38.4	32.2	32.1
	Average	49.8	49.8	40.1	39.1	34.6	34.1
Sahel	Burkina Faso	29.1	35.8	29.3	39.0	35.4	33.8
	CAR	47.6	46.2	55.9	54.4	-	-
	Chad	29.3	35.8	42.3	12.3	-	-
	Mali	45.5	49.5	41.6	36.6	-	-
	Niger	35.3	40.2	37.8	-	-	-
	Average	37.4	41.5	41.4	35.6	35.4	33.8
East Asia	Bhutan	35.3	32.0	27.4	23.2	17.5	15.9
	LAO PDR	61.2	55.7	45.2	36.2	32.7	30.8
	Mongolia	12.9	34.4	30.9	22.1	16.2	14.5
	Nepal	51.6	41.8	40.8	36.3	36.5	38.1
	Average	40.2	41.0	36.1	29.9	26.0	24.7
West Asia	Afghanistan	-	-	-	31.8	27.1	24.3
	Armenia	17.4	42.3	25.5	20.9	19.6	20.7
	Kazakhstan	-	12.9	8.7	6.8	4.8	5.5
	Kyrgyzstan	33.5	43.9	36.7	31.9	19.4	18.6
	Tajikistan	33.3	38.4	27.4	24.0	21.2	26.7
	Turkmenistan	32.2	17.2	24.4	18.8	14.5	14.5
	Uzbekistan	32.8	32.3	34.4	28.0	19.3	19.1
	Average	29.8	31.2	26.2	21.7	16.5	17.5
South America	Bolivia	16.7	16.9	15.0	14.4	12.9	12.5
	Paraguay	-	20.1	15.8	19.6	22.5	21.4
	Average	16.7	18.5	15.4	17.0	17.7	17.0
Eastern Europe	Moldova	36.1	33.0	29.0	19.5	14.4	14.8
	Macedonia	8.5	13.2	12.0	12.3	11.5	11.0
	Average	22.3	23.1	20.5	15.9	13.0	12.9

Source: UNEP Geo Data; <http://geodata.grid.unep>



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