

Inclusive Green Growth in Ethiopia: Selected case studies

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Abbreviations and acronyms

ADLI	Agricultural Development - Led Industrialization
AfDB	African Development Bank
BRT	bus rapid transit
CDKN	Climate and Development Knowledge Network
CDMCC	Clean Development Mechanism
CRGE	Climate- Resilient Green Economy
CSA	Central Statistical Agency
DNA	designated national authority
EC	European Commission
ECA	Economic Commission for Africa
EEPCCO	Ethiopian Electric -Power Corporation
EREDPC	Ethiopian Rural Energy Promotion and Development Center
ESDA	Ethiopian Sugar Development Agency
EthIOCAT	Ethiopian Overview of Conservation Approaches and Technologies
FAO	Food and Agricultural Agriculture Organization of the United Nations
FCPF	Forest Carbon Partnership Facility
FCs	Forest Cooperatives
FUG	Forest User Group
GDP	gross domestic product
GIZ	German Agency for Technical Development Cooperation
GTP	Growth and Transformation Plan
GTZ	German Technical Cooperation
IARC	international agricultural research centres
IFAD	International Fund for Agricultural Development
IMF	International Monetary Values
JICA	Japanese International Cooperation Agency
LPG	liquefied petroleum gas
LRT	light rail transit
MRV	Measurement, reporting and verification
NAMA	nationally appropriate mitigation action
NBPCO	National Biogas Programme Coordination Office
NGO	non-governmental organization
NTFP	non-timber forest products

OFSP	Other Food Security Programme
PASDEP	Plan for Accelerated and Sustained Development to End Poverty
PDDIGG	product design document
PFMMDG	participatory forest management
PSNP	Productive Safety Net Programme
RBPCO	Regional Biogas Programme Coordination Office
REDD	reduction emission from deforestation and degradation
SDPRP	Sustainable Development and Poverty Reduction Programme
SDRA	Sustainable Development Report on Africa
SLM	sustainable land management
SNNPNRP	Southern Nations Nationalities and Peoples
SNV	Netherlands Development Organization
TVET	technical and vocational education and training
TVT	technical vocational training
UNEP	United Nations Environmental Programme
USAID	United States of America Agency for International Development
VAT	value added tax

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Executive summary

Introduction

The present report documents good practices and lessons learned on inclusive green growth in four key sectors of the Ethiopian economy: agriculture and land use management; forestry; energy; and transport. These sectors were selected on the basis of their contribution to promoting inclusive green growth and informing the transition to the green economy in Ethiopia. The case studies drawn from the sectors were selected based on their actual or potential contribution to the economic, social and environmental well-being of the country. Other important criteria for the selection were the studies' implementation design, sustainability and replicability.

Objectives

The main objective of the report is to document good practices and lessons learned on inclusive green growth in selected sectors of the Ethiopian economy. The report was used as input for the preparation of the fifth issue of the Sustainable Development Report on Africa (SDRA-V) prepared under the theme "Achieving sustainable development in Africa through inclusive green growth".

Green economy and inclusive green growth in the context of Ethiopia

The economy of Ethiopia is largely dependent on the performance of the agriculture sector, which accounts for 46.3 per cent of gross domestic product (GDP), 60 per cent of exports and 80 per cent of total employment. The livestock subsector contributes 12-15 per cent of the overall GDP. Coffee is the main export crop, accounting for

about 26.4 per cent of the country's foreign exchange earnings, and supporting the livelihoods of more than 15 million people (25 per cent of the population). Smallholder farmers constitute the largest share of the agricultural labour force, accounting for more than 95 per cent of total food production. The growth of GDP is, however, hampered by climate change impacts on the performance of the agriculture sector, particularly on livestock and crop production. Such impacts include recurrent droughts and soil degradation in the semi-arid areas of the country.

Within the context of the country's Climate-Resilient Green Economy (CRGE) strategy of 2011, the green economy is defined as sustainable economic development that is resilient to climate and environmental shocks, creating a competitive advantage out of sustainable use of resources and higher productivity growth, as well as overcoming the possible conflict between economic growth and climate change mitigation. In this context, inclusive green growth initiatives in the country embodies four pillars of the Strategy: (a) improving cropland livestock production for higher food security; (b) protecting and re-establishing forests for economic and ecosystem services; (c) expanding electricity production from renewable energy for wide domestic consumption and the regional market; and (d) leapfrogging to using modern and energy-efficient technologies in the transport, energy and industry sectors. These four pillars embody the three dimensions of sustainable development – environmental, social and economic. Using this framework, Ethiopia could double its GDP by 2030 by adopting a green growth path.

Policy framework, position and mechanisms to promote inclusive green growth in Ethiopia

To ensure rapid economic growth, the Government of Ethiopia has been implementing a series of policies and strategies in various economic sectors. They are: (a) Sustainable Development and Poverty Reduction Programme (SDPRP, 2000-2005); (b) New Coalition for Food Security (2003); (c) Agricultural Growth and Rural Development Strategy and Programme (2004); (d) Food Security Programme (2004); (e) Productive Safety Net Programme (PSNP, 2004); (f) Plan for Accelerated and Sustained Development to End Poverty (PASDEP, 2006-2010); and (g) Growth and Transformation Plan (GTP, 2011-2025). These policies were formulated around the general framework of the country's long-term strategy of agricultural development-led industrialization (ADLI), which was set in the early 1990s.

The formulation of GTP was based on experience gained in the implementation of PASDEP. GTP is a five-year strategic plan, which is aimed at fostering sustainable development in efforts to achieve the Millennium Development Goals through targeted investments in selected sectors. It is hoped that through the implementation of GTP, Ethiopia will be able to transition from a least developed country to a middle-income country by 2025. Federal and regional governments are responsible for implementing GTP with support from development partners. The seven policies listed above, however, do not adequately respond to opportunities, and challenges posed by climate change, as well as the pressure on natural resources and ecosystems resulting from economic, and rapid population growth. Therefore, in order to deal with the impacts of climate change, and at the same time ensure that the economy is on a sustainable development path, the Government formulated the CRGE strategy towards building a green economy.

The CRGE strategy is intended to contribute to the realization of the goals of GTP (2011-2025), particularly the one of reaching middle-income status by 2025, while at the same time minimizing emissions and ensure the sustainable use of natural resources. To complement the Government's efforts, the World Bank supported the establishment of the Ethiopia Climate Innovation Center in 2011 and funded the establishment of the Forest Carbon Partnership Facility (FCPF).

Case studies on inclusive green growth in Ethiopia

Agriculture and land use management

Sustainable land management project

The Ethiopian sustainable land management project was initiated to reverse the serious level of land degradation by promoting and scaling up successful sustainable land management (SLM) technologies and approaches. It is a comprehensive approach to sustainable land resources and integrated watershed management that tackles interlinked problems of poverty, vulnerability and land degradation at the rural community level by overcoming key barriers, including those that pertain to knowledge and technology and policy, legal, institutional, economic and financial issues.

The project has a capacity-building component, which includes: developing a SLM knowledge base; and creating the necessary enabling policy and legal, institutional and financial environment within areas that have been identified as being in immediate need of priority attention. The other component of the project entails harnessing social infrastructure for natural resource management to support community participation and the mobilization of labour-intensive physical and vegetated structural and agronomic land management practices at the watershed level in agricultural, pasture and degraded lands.

Forestry

Participatory forest management

Participatory Forest Management is a forest management system that was introduced as a complementary mechanism to safeguard forests, while respecting traditional users and including them in the process. The general and common component of the system is its focus on community participation in forest management. This includes agreeing with government institutions or landowners on management plans and the sharing of responsibilities, costs and benefits between a given community and landowners.

The aim of Participatory Forest Management is: to improve forest productivity and promote efficient use of the forest resources; to secure use rights for communities and to develop a sense of ownership, appreciating livelihood needs of various interest groups; and to build the institutional capacity and awareness of stakeholders. The approach is used as a mechanism to protect the remaining natural forests by tackling problems related to open access to forest resources and enhancing the livelihoods of communities that use and benefit from them. Participatory Forest Management is essential for Ethiopia for two reasons: (a) mitigating biodiversity loss, forest degradation and deforestation; and (b) safeguarding livelihoods in forest-neighbouring areas, as well as the rights to utilize forest resources legally.

Energy

Ethanol-burning clean cook stove

An ethanol-burning clean cook stove is non-pressurized and contains a special fibre-filled canister, which absorbs ethanol to prevent spillage. The ethanol evaporates into a combustion chimney in which the alcohol burns in a gaseous form, similar to liquefied petroleum gas (LPG) or natural gas. In three-year pilot studies, it was shown that in the ethanol-burning clean stoves in Ethiopian homes, one measure of ethanol fuel displaced at least one

measure of kerosene fuel, even though kerosene has a 43 per cent higher energy content than ethanol. This is because an ethanol stove operates at a 74 per cent higher efficiency rate than a kerosene wick stove. Thus, usage of a clean cook stove would cut the need to import kerosene for cooking. This is highly significant with regard to import substitution, given that the Ethiopian urban household cooking sector is kerosene-dependent and is the second largest consumer of fossil fuels after the transport sector. The replacement of kerosene stoves with clean cook stoves would help to overcome the acute shortage of energy and reduce household expenditure on fuel wood, particularly in rural areas where access to electric power is limited.

National Biogas Programme Ethiopia

The Government, with financial and technical support from the Netherlands Development Organization (SNV) Ethiopia, has launched the National Biogas Programme Ethiopia (NBPE) to promote the uptake of domestic biogas and to develop a commercially viable market biogas sector in the country. The plan is to be undertaken by the Ethiopian Rural Energy Promotion and Development Center (EREDPC) of the Ministry of Water and Energy in the off-grid rural areas through the up-scaling of the National Biogas Programme (NBP). The project is being implemented under the GTP and CRGE strategy to expand renewable energy sources by adding at least 70,000 biogas digester units by 2015.

A feasibility study was commissioned by SNV to assess the features and functions required for the establishment of a NBP, as well as review the future prospects of domestic biogas in the country. The launching of NBPE took place following the feasibility studies conducted by the Government of Ethiopia. The goal of the Programme is to improve the health, livelihood and quality of life of rural households by exploiting the market and non-market benefits of domestic biogas, such as its potential to be used as a substitute for biomass for cooking and lighting and as a high-value or-

ganic fertilizer from bio-slurry. The Programme comprises eight major components: promotion and marketing; training; quality management; research and development; monitoring and evaluation; institutional support; extension; and gender mainstreaming.

Hydropower development projects

Ethiopia has vast potential with regard to the production of hydropower (about 15,000 - 30,000 MW), which is the main source of power generation, accounting for 95 per cent of the total generation capacity on the national grid. One large hydropower expansion project is aimed at expanding generation capacity from the current 1,500 MW on the national grid to 13,000 MW by 2030. Some 300 hydropower plant sites in eight river basins with a total technical power potential of 159,300 Gwh/year have been identified. Out of those potential sites, 102 are large scale (more than 60 MW) and the rest are small (less than 40 MW). The development of medium-scale (40-60 MW) hydropower plant sites have also been initiated to generate more hydroelectric power. Substantial progress has been made in exploiting this vast hydropower potential in order to achieve sustainable energy supply. By 2018, the total available hydropower supply is expected to reach about 12,011 MW – more than 40 per cent of the maximum potential.

Transport

National railway and bus rapid transit projects

Two interlinked projects geared towards the development of the transport sector are being undertaken. They are core investment projects in line with the goals of GTP and CRGE and are expected to foster economic development while keeping greenhouse gas emissions at the present level. The objective of the projects is to shift freight transport from road to an electric rail network to minimize emissions from the largest source in the transport sector and to promote economic efficiency.

Key aspects of the projects are the following: the construction of an electric rail network powered by renewable energy, which would serve as alternative to road freight transport on the major import-export corridor; the enhancement of urban transport in Addis Ababa by introducing urban electric rail and enabling fast and efficient bus transit; the introduction of stricter fuel efficiency standards for passenger and cargo transportation; and the promotion of hybrid and electric vehicles to counter the low efficiency of the existing vehicle fleet. The national railway network comprises seven routes; the construction of the route that connects Ethiopia (Addis Ababa) with Djibouti has commenced. The route is the major import-export corridor of the country. With regard to bus rapid transport (BRT), an urban development study conducted in 2005 recommended the construction of a light rail transit (LRT) system for the North-South corridor and a BRT system for the East-West corridor in Addis Ababa. The two transit line systems are already under construction.

Conclusion and recommendations

Ethiopia is one of the first African countries to embrace inclusive green growth and green economy in its development agenda. And, government commitment was critical in implementing the projects showcased in this study. This has been demonstrated through the adoption of GTP and the CRGE. The Government has also recognized the need to establish well-resourced and dedicated institutions with effective governing structures and capacity for implementation. In addition, the promotion of public-private partnership ventures and international partnerships in implementing its CRGE has enabled the Government to meet the high initial investment cost and facilitate access to green investment funds. The Government has also shown its commitment to the concept by putting in place policies that promote technology development and transfer. These policies have to some extent facilitated technology transfer by development partners, financial institutions and the private sector.

The challenges going forward are many, including financial sustainability and sustaining the momentum commitment in the implementation process, particularly through institutional stability. This is especially important because the key sectors highlighted in the case studies have been domiciled under different institutional set-ups. The water, energy, agriculture and forestry sectors are very relevant to the promotion of inclusive green growth, but the performance and development of these sectors have been affected by frequent restructuring. For example, the energy sector was under the Ministry of Mining and Energy until it merged with the water sector to form the Ministry of Water and Energy. Likewise, the forestry sector has been repeatedly disbanded, amalgamated with or subsumed into other departments within the Ministry of Agriculture or re-established as a stand-alone institution. These frequent institutional restructurings usually affect professional commitment and can result in high staff turnover, disintegration of information databases and discontinuity of planned activities, and limited awareness, knowledge and technical capacity.

Furthermore, financial sustainability of the projects is a significant obligation to the Government, as well as to the people of Ethiopia. For instance, increasing electricity generation from renewable energy sources to secure domestic consumption through rural electrification and regional markets is capital- and technology-intensive, requiring an estimated budget allocation of more than \$150 billion. The correct valuation of the final products will be critical for achieving financial sustainability, and ensuring social inclusiveness of the resulting benefits.

In view of the above, the report recommends the following:

(a) Acknowledging the importance of GTP and CRGE with regard to the development aspirations of Ethiopia as they provide the most coherent framework for attaining various goals,

including fostering inclusive green growth for building a green economy.

- (b) Harmonizing regional development plans with the national strategies embodied in GTP and CRGE. This action will be critical for the success of the inclusive green economy agenda.
- (c) Taking stock of community and regional projects, as they are instrumental in empowering communities and have the potential to foster inclusive green growth in a way that provides wider social benefits if they are implemented through collaborative efforts between the government and development partners on one hand, and between the partners and stakeholders on the other. Projects that have technology development and transfer as a component of implementation are likely to have the greatest impact.
- (d) Carefully planning large-scale projects that are likely to affect a large population so that they cater to the various needs of the population. Adequate consideration must be given to the potential impacts, such as resettlements and displacements, and welfare policies, so as to balance infrastructure development with social progress.
- (e) Evaluating and monitoring the governance of the various inclusive green growth projects under GTP and CRGE to ensure that the projected benefits trickle down to the intended constituents of society.
- (f) Training and upgrading of skills, which is a critical aspect in innovation, technological development and transfer, and in upscaling projects. Involvement of women and young people from the onset of project design and implementation could help in promoting social inclusion, transfer of knowledge and skills development.

I. Introduction and background

A. Introduction

In the present report, good practices and lessons learned on inclusive green growth in selected sectors of the Ethiopian economy are documented. These served as input to SDRA-V, which was prepared under the theme “Achieving sustainable development in Africa through inclusive green growth”. In addition to Ethiopia, other case studies were conducted in Ghana, Morocco and South Africa. The report is based on information collected from research publications, conference proceedings, government reports, discussions with experts and Internet reports.

In the report, good practices in four key sectors that are thought to be relevant in promoting inclusive green growth and fostering the transition to the green economy in Ethiopia have been identified. The sectors covered are agriculture and land use management, forestry, energy and transport. Six case studies on inclusive green growth in Ethiopia are discussed in relation to their actual contribution or potential in realizing economic, social and environmental benefits based on their implementation design, sustainability and replicability, and on relevant cross-cutting issues. Key challenges and existing opportunities, as well as lessons learned, are discussed in terms of institutional instability, financial sustainability and policy implementation. Recommendations drawn from lessons learned are highlighted to better inform the implementation of inclusive green growth initiatives.

B. Background

A range of definitions on the green economy, green growth and inclusive green growth have been sourced from, among others, OECD, 2011; Apollo Alliance and Green, Center for American

progress and Center on Wisconsin Strategy, 2008; Green-collar jobs in America’s cities: Building pathways out of poverty and careers in the clean energy economy, 2008; and World Bank, 2012. For the purpose of this report, the definition of inclusive green growth is as follows “economic growth that is inclusive, creates jobs, improves human welfare and efficient resource use, enhances environmental assets, thus contributing to sustainable development” (ECA, 2013). In the Ethiopian context, the definition of inclusive green growth embodies four pillars of the country’s CRGE strategy: (a) improving cropland livestock production for higher food security; (b) protecting and re-establishing forests for economic and ecosystem services; (c) expanding electricity from renewable energy for wide domestic consumption and the regional market; and (d) leapfrogging to modern and energy-efficient technologies used by transport, energy and industry sectors. These embody the three dimensions of sustainable development – environmental, social and economic.

At the most basic level, promoting green growth and building a green economy is about ensuring human well-being in a world undergoing rapid transformation by balancing and reconciling economic, social and environmental objectives. With regard to inclusive green growth, a range of definitions have also been put forward.

World Bank (2012) defines inclusive green growth as growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and inclusive for the population. This range of definitions recognizes that the current growth patterns are not only just unsustainable, but are also deeply inefficient, thus engendering a profound sense of urgency at all levels. This calls for a shift from the current model of economic growth towards a greener, more sustainable and inclusive development

model that integrates the economic, social and environmental dimensions in a balanced manner, and takes into account intergenerational equity.

Within the context of the Ethiopian CRGE (Ethiopia, 2011), the green economy is defined as sustainable economic development that is resilient to climate and environmental shocks, creating a competitive advantage out of sustainable use of resources and higher productivity growth, as well as overcoming the possible conflict between economic growth and fighting climate change. This definition is being applied to the sectors identified to build the four pillars of CRGE.

The new growth model will catalyse investment and innovation for sustained growth and give rise to new economic opportunities for present and future generations through job creation, by ensuring social equity and gender equality and through equitable sharing of benefits of economic development, environmental and natural resource safeguards.

From the viewpoint of these definitions, an important question to be considered pertaining to inclusive green growth is the extent to which the economic development initiatives in Ethiopia could provide social, economic and environmental benefits.

To ensure rapid economic growth, the Government of Ethiopia has implemented a series of policies and strategies in various economic sectors. These are: (a) SDPRP, 2000-2005; (b) New Coalition for Food Security (2003); (c) Agricultural Growth and Rural Development Strategy and Programme (2004); (d) Food Security Programme (2004); (e) PSNP, 2004; and (f) PASDEP, 2006-2010). These programmes are guided by a general framework of the country's long-term strategy of ADLI, which was formulated in the early 1990s. The implementation of these policies fostered substantial economic growth with annual average GDP growth of 8-11%. Since the Ethiopian economy is largely dominated by the agriculture

sector, the country's economic development has been and continues to be challenged by a long history of climate change impacts and variability as manifested by recurrent famines resulting from cyclic droughts and floods. The compound effects of land resource degradation and climate change continue to hamper efforts of the Government to eradicate poverty.

In addition to the negative effects of climate change, the phenomenon itself has become the driving factor in switching to a new sustainable development path. Opportunities include financial support and technology transfer being facilitated through ongoing climate change negotiation efforts. The Government of Ethiopia has, therefore, initiated the CRGE strategy to protect the country from the adverse effects of climate change and to build a green economy that will contribute to realizing the goals of GTP, 2011-2025 of reaching middle-income status by 2025, while at the same time reducing the sharp increase in greenhouse gas emissions and ensuring sustainable use of natural resources.

C. Methodological approach

The report was prepared through a comprehensive literature review. This included research publications, conference proceedings and presentations and reports prepared by sector ministries and various organizations. The documents used as reference materials for the desk review were collected in three ways: (a) accessing Internet-based documents from various organizations' websites; (b) accessing peer-reviewed scientific journal articles; and (c) discussing with experts in various government ministries, agencies and other organizations.

The report documents six case studies in four sectors relevant to the current drive aimed at greening the Ethiopian economy; agriculture and land use management; forestry; transport; and energy. The case studies were selected and

discussed in relation to their actual contribution or potential in providing economic, social and environmental benefits. Challenges, constraints and opportunities as well as lessons learned are also discussed. Recommendations were drawn from the good practices and lessons learned. The report was peer reviewed at the Ad hoc Expert Group Meeting on SDRA-V held in December 2013 and finalized on the basis of the comments and recommendations of the meeting.

II. Contextualizing the green economy and inclusive green growth

A. Definitions

There are a range of definitions on green economy, such as those provided by Apollo Alliance and Green, Center for American progress and Center on Wisconsin Strategy (2008) and on green growth, such as the one provided by OECD (2011) and on inclusive green growth, such as ones provided by ECA (2013); and World Bank (2012). The United Nations Environment Programme (UNEP) defines green economy as one that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities UNEP (2011).

Karl Burkart (as cited in Apollo Alliance and Green, Center for American progress and Center on Wisconsin Strategy (2008) reports that the green economy can be applied to six main sectors: (a) renewable energy (solar, wind, geothermal and marine, including wave, biogas and fuel cell); (b) green and energy-efficient technology (green retrofits for energy and water efficiency, residential and commercial assessment, green products and materials, and leadership in energy and environmental design construction); (c) clean and energy-efficient infrastructure (alternative fuels, public transport, hybrid and electric vehicles, car-sharing and car-pooling programmes); (d) water management (water reclamation, grey water and rainwater systems, low-water landscaping, water purification and storm water management); (e) recycling and waste-to-energy management (recycling, municipal solid waste salvage, brownfield land remediation, superfund cleanup and sustainable packaging); and (f) land management (organic agriculture, habitat

conservation and restoration, urban forestry and parks, reforestation and afforestation and soil stabilization). These applications should embody the three dimensions of sustainability.

At the most basic level, a green economy is one that generates increasing prosperity, while maintaining the natural systems that sustain human well-being. A green economy is not just about producing clean energy, but is also about applying technologies that allow cleaner production processes and a growing market for products that consume less energy, such as fluorescent light bulbs or for organic and locally produced food. Thus, clean energy is the core of a green economy. Furthermore, it might include products, processes and services that have less environmental impact or improved natural resource use (Buffa and others, 2008). The switch to clean energy will improve environmental quality by reducing greenhouse gas emissions and affect sustainability by reducing energy use.

OECD (2011) defines green growth as fostering economic growth and development while at the same time ensuring that natural assets continue to provide the resources and environmental services on which human well-being relies. Meanwhile, green growth was defined by UNEP as “resource-efficient, low-carbon, climate-resilient and socially inclusive growth” and World Bank (2012) defined it as “a strategy for promoting economic growth while adding an ecological quality to existing economic processes and creating additional jobs and income opportunities with a minimal environmental burden”. At the most basic level, promoting green growth and building a green economy is about ensuring human well-being

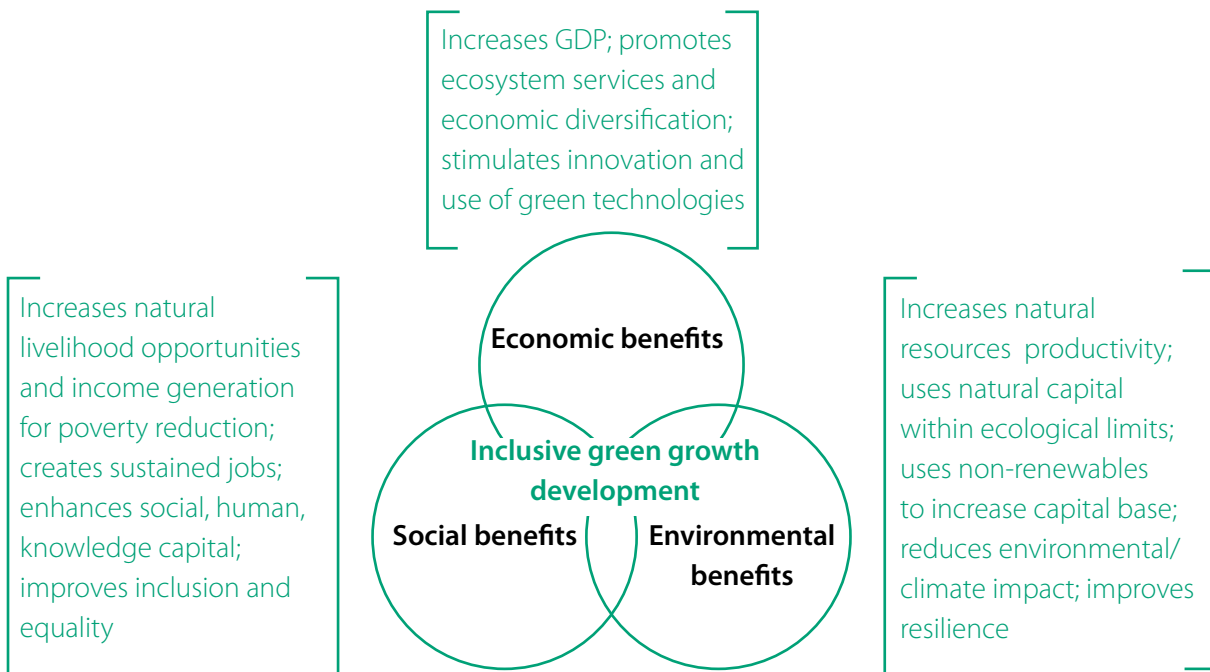
in a world undergoing rapid transformation by balancing and reconciling economic, social and environmental objectives.

On a global scale, these development processes need to become more resource efficient, less polluting, more inclusive and resilient, if the needs of a growing world population are to be met. According to World Bank (2012), current growth patterns are not just unsustainable, they are also deeply inefficient; as a result, they stand in the way of sustainable development and its objectives of social, environmental and economic stability. Thus, there must be a shift towards a greener, more sustainable and inclusive development model.

In this respect, the World Bank has proffered the following definition of inclusive green growth: growth that is efficient in its use of natural resources, clean in that it minimizes pollution and environmental impacts, and

inclusive for the population. In the present report, the inefficiencies that offer opportunities for cleaner growth is examined, the need to navigate between market and governance failures is explored, the roles of human, natural and physical capital is reviewed and lessons learned are filtered through a political lens in order to extract a green growth strategy and policy recommendations. Also, the report further articulates that inclusive green growth is a three-pronged strategy for tackling the risk of lock-in, entrenched interests and behaviours, and financing constraints that can stand in the way of achieving it. This growth model, therefore, would catalyse investment and innovation that would strengthen sustained growth and give rise to new economic opportunities for present and future generations through job creation, ensuring social and gender equity, as well as equitable benefit sharing of economic development, environmental and natural resource safeguards (figure 1).

Figure 1: Conceptual framework of the green growth model: synergy between economic, social and environmental objectives in a green growth development path



This range of definitions indicates that the current growth patterns are not only unsustainable, but they are also deeply inefficient; hence, the profound sense of urgency at all levels that there should be a shift from the current model of economic growth to a greener, more sustainable and inclusive development model that integrates the economic, social and environmental dimensions in a balanced manner, and takes into account intergenerational equity.

Based on these definitions, an important question to consider is the extent to which the economic development initiatives in Ethiopia could provide social, economic and environmental benefits, as espoused by the concept of inclusive green growth. This is discussed in the sections below in terms of the macroeconomic environment, social and environmental development imperatives and the policy environment.

B. Overview of the macroeconomic environment

As indicated in table 1 below, during the period 2003-2004, Ethiopia registered an annual average GDP growth rate of 11 per cent, while it posted an annual average decline of 1 per cent, from 9 per cent during 2004/2005 fiscal year to 6 per cent during 2008/2009 fiscal year (Ethiopia, 2010c; Ethiopia, 2010d). Negative growth of real incomes expressed as real GDP of -1 per cent and -5 per cent was recorded during the fiscal years of 2001/2002 and 2002/2003. Between 2000 and 2009, overall average real GDP growth was positive, with annual average growth exceeding 5.4 per cent.

Economic growth in Ethiopia is largely dependent on the performance of the agriculture and forest sector, which accounts for 46.3 per cent of GDP, 60 per cent of exports and 80 per cent of total employment of the labour force.

Table 1: Average growth in real GDP per capita in Ethiopia as inferred from various sources

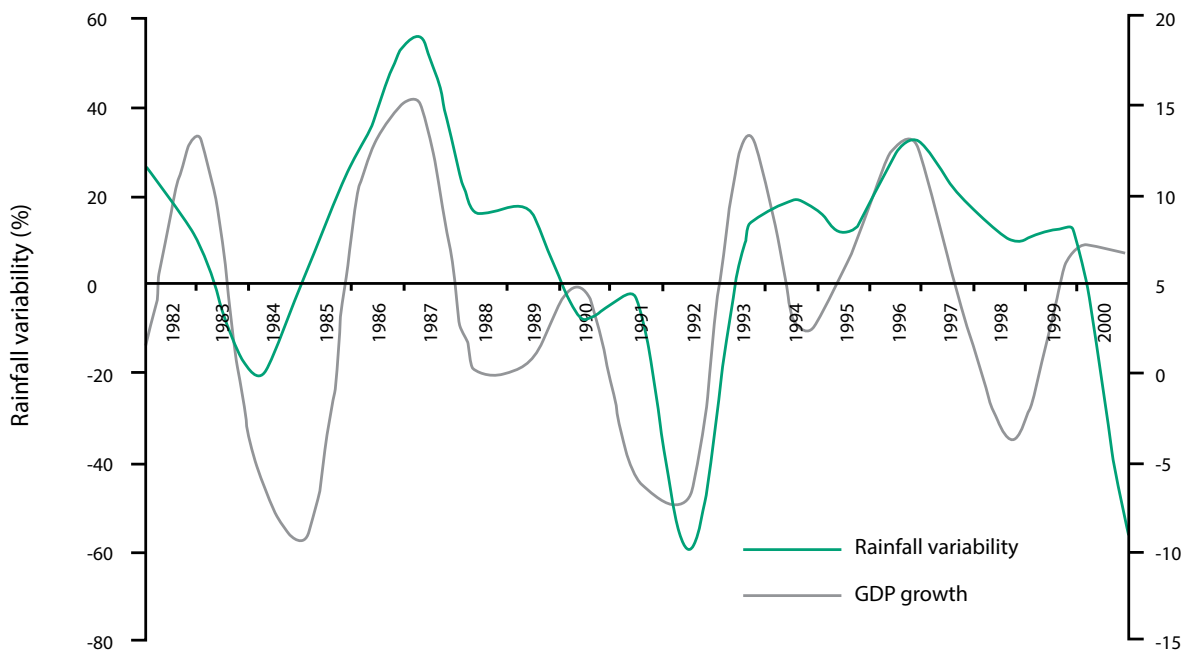
Year	Real GDP (percentage)	Sources
1982-1986	-3	ECA (2002), FDRE (1999), FDRE (2002) and World Bank (2002), all as cited in Denu and others (2005)
1987-1991	0.9	
1992-1996	1.8	
1997-2001	2.0	
2000/2001	6	FDRE (2010c) as estimated by Alebachew (2010)
2001/2002	-1	
2002/2003	-5	
2003/2004	11	
2004/2005	9	
2005/2006	8	
2006/2007	8	
2007/2008	7	
2008/2009	6	
2005/6-2009/10	11	

The livestock subsector contributes 12-15 per cent of the overall GDP, and 25-30 per cent of the agricultural GDP (FAO, 2004). Exports are almost entirely comprised of agricultural commodities of the cash crop subsector. Coffee provides about 26.4 per cent of the country’s foreign exchange earnings, and more than 15 million people (25 per cent of the population) derive their livelihood from the coffee subsector (Luxner, 2001). Coffee exports from Ethiopia represented 0.9 per cent of global coffee exports, while oilseeds and flowers each represented 0.5 per cent (IMF, 2008). Ethiopia is the Africa’s second largest maize producer (Anonymous, 2007). Smallholder farmers, who generally are concerned with meeting their subsistence, constitute the largest share of employment in the labour force, accounting for more than 95 per cent of the country’s total food production.

The forestry sector contributes, on average, 5.7 per cent of the total GDP (Nune and others, 2010); if other forest-derived products, such as honey, beeswax and wild coffee are included in the computation, the actual value would be closer to 9 per cent of GDP, placing the forestry sector third after the agricultural and the service sectors.

Growth of GDP is, however, hampered by climate change due to the combined effects of recurrent drought and soil degradation on the performance of the agriculture sector, particularly with regard to livestock and crop production (see figure 2).

Figure 2: Correlation between rainfall variability and GDP in Ethiopia



Source: Petherick, 2012.

C. Social sustainability

The population of Ethiopia has been growing at an annual rate of 3 per cent, with projections indicating that it will increase from 79 million in 2010 to above 116 million in 2025. Despite the country's economic growth, its poverty level remains high, but is a bit lower than the average level for the Africa as a whole. According to the Human Development Report (UNDP, 2013) about 39 per cent of the Ethiopian population lived below the income poverty line (the official poverty line is \$1.25 a day based on purchasing power parity in 2011). Notably, the number of people living below the poverty level varies widely among regional states, ranging from 48.5 per cent in Tigray to 27 per cent in Harari (Alebachew, 2010).

Additionally, various studies, including those of Broussar and Tekleselassie, 2013; and Denu and others, 2005, indicate that Ethiopia is confronted with a staggering level of unemployment, particularly among young people. Based on data of Ethiopia (2012), Broussar and Tekleselassie (2012) reported that the youth population, as defined as individuals between the ages of 15 and 29, totalled more than 20 million in 2007, representing 28 per cent of the population. This figure was 20 per cent if the ages used to define youth were 15 to 24 years. Broussar and Tekleselassie (2012) presented detailed accounts of unemployment, particularly youth unemployment in Ethiopia. Accordingly, the proportion of unemployed youth, those between the ages of 15 and 24, comprised 28 per cent of labour force, down from 35 per cent in 1999.

With regard to gender equity, the majority of women in Ethiopia hold a low status in the society. For instance, women account for only 23.9 per cent of the workers in technical and professional fields (Ethiopian Society of Population Studies (2008).

At the national level, the unemployment rate for young women (ages 15-29) was 16 and 11

per cent in 1999 and 2005, respectively, while it was 6 and 4 per cent for young men in that age category during those same years (Broussar and Tekleselassie, 2012).

This study by Broussar and Tekleselassie (2012) found that women made up about 52 per cent of the youth labour force and that 67 per cent of all unemployed young people were women. Comparing rural and urban areas, the female youth unemployment rate in rural areas was 6 per cent in 2005, compared to just 1 per cent for male youths in the same year. In urban areas in the years 1999, 2005, 2008 and 2011, the unemployment rate for female youths was 42, 33, 34 and 30 per cent, respectively, compared to 25, 19, 17 and 16 per cent for male youths in the same years. Women are more likely to be engaged in the informal sector, with the rate reaching as high as 41 per cent in 2011. This indicates that the majority of women perform tedious, low-paid and even unpaid jobs, despite the formulation of several laws and policies by the Government to promote gender equality and mainstream gender into all sectors. In 2005, a full-fledged ministry was established with a view to ensuring the participation and empowerment of women in political, economic, social and cultural affairs.

These figures stand in contrast with the general trend for the sub-Saharan region, where the average unemployment rates for young men (23.1 per cent) exceeded those for young women (18.4 per cent) (Broussar and Tekleselassie, 2012). The differences between male and female in labour market outcomes could be driven by differences in gender and skills. Detailed studies by Broussar and Tekleselassie (2012) suggest that women with the least education fare the worst in the labour market relative to men with the same education. A comparison of women and men shows that women are more likely to have no education and less likely to complete lower secondary or obtain some form of higher education. Despite the Government's policy against child labour, 50 per cent of all 5- to 14-year-olds were involved in child labour.

This unemployment situation can be explained by several factors, including the mismatch between the skills requirements of the labour market on the one hand, and the education and skills of the youth on the other. Another factor is the declining trend in the number of the self-employed, which is caused by large youth migration to urban areas and lack of access to credit. The declining trend of self-employment indicates that despite the departure from a command system of economic management, economic liberalization process has not gone far enough and that government-affiliated companies still have an increasing role in the economy (Denu and others, 2005). Additionally, weather patterns, such as drought, and socioeconomic factors, such as lack of skills, low availability of investment, capital, risk absorption capacity and financial management skills, poor infrastructure and limited market accessibility and the absence of youth in decision-making or the implementation of policies are the main causes of the youth employment problem in Ethiopia.

D. Environmental sustainability

Environmental sustainability issues in Ethiopia can be defined in terms of changes in forest cover, degradation of land and water resources, biodiversity loss and subsequent decline in soil fertility, leading to a substantial reduction in agricultural production.

Forest resources in Ethiopia are believed to be at the core of environmental sustainability. Forest cover in Ethiopia was estimated at about 33 per cent in the early 1900s, but there is no consensus about this figure. Historical reconstructions of vegetation shifts suggest that the country has experienced prolonged deforestation. A series of studies indicate that natural high-forest cover changed from 16 per cent in the 1950s (Breithenbach, 1962) to 2.7 per cent in 1985 (Pohjonen and Pukkala, 1990). If woodland and wooded vegetation had been considered as the

resource base of the forestry sector, then the forest resource sector would have a cover of 50 per cent of the total land mass (WBISPP, 2004). Recent estimates indicate that forests and woodlands continued to be lost at a rate of 140,000 ha annually, even though the rate of afforestation and reforestation of degraded lands, as well the increase in the number of trees on farmlands have brought the country's forest cover to above 11 per cent (FAO, 2010).

This severe forest degradation has resulted in substantial socioeconomic impacts. Berry and others (2003) estimate that some 30,000 ha of fertile land are lost annually, with an annual loss of 1.5 billion tons of topsoil, and nutrient losses of about 30 kg/ha/yr of nitrogen and 15-20 kg/ha/yr of phosphorous due to soil erosion caused by wind and water. Additionally, about 4,000 ha of irrigated land have been abandoned due to soil salinity. This severe land degradation combined with climate anomalies hamper GDP growth (see figure 2), with economic costs of land degradation equivalent to 8 per cent of agricultural GDP (equivalent to 4 per cent of the country's GDP) in 1999 (Ethiopia, 2010a). As a result, the gap between the demand for and the supply of wood products has increased. This has aggravated illegal timber harvests; and forced the country to spend the equivalent of over \$179 million on importing a total of 17,0721 tons of wood and forest-related products, including wood particles, wood pulp, paper and paper board, and gum and resin in 2012 (CSA, 2013).

The extensive deforestation has contributed substantially to the build-up of greenhouse gas emissions. According to Government estimates, greenhouse gas emissions in Ethiopia amounted to 150 Mt ton CO₂ equivalent in 2010. This amount is expected to increase to 400 Mt CO₂ equivalent by 2030. The agriculture and forestry sectors contribute 85 per cent of the greenhouse gas emission emissions, while the power, transport, buildings and industry sectors each contributed about 3 per cent.

Large-scale deforestation and associated development projects has led to the degradation of wetlands and their ecosystem components (Tenalem Ayenew, 2012). As a result, there has been a substantial reduction in the size, biodiversity and water resources of lakes and their wetlands. In line with that, the environmental and socioeconomic benefits from those areas have also declined substantially. The most common threats to the Ethiopian wetlands as a result of the mismanagement of land resources are: (a) excessive water withdrawals for irrigation and industrial uses; (b) siltation due to extensive deforestation around the wetland zones; (c) nutrient loading from the surrounding agricultural

activities and domestic wastes; (d) agricultural and urban effluents emanating from the expansion of towns around the wetlands; (e) overfishing; (f) clearing of riparian forests and vegetation; (g) seasonal farming of wetlands to earn cash during the dry season; and (h) the expansion of invasive species, leading to eradication of indigenous species.

These anthropogenic activities, combined with natural factors, have ultimately resulted in not only the shrinking of the wetlands, but also the disappearance of lakes and their wetland ecosystems, as in the case of Lake Haromaya.

III. Selected Inclusive Green Growth Case Studies in Ethiopia

A. Introduction

The following sections present the policy environment and case studies on inclusive green growth in Ethiopia in four sectors: (a) agriculture and land management; (b) forestry; (3) energy; and (d) transport. The case studies look at their design and implementation, their expected and realized outcomes and impacts, cross-cutting issues, sustainability and replicability, and lessons learned.

B. Policy environment for green economy and inclusive green growth in Ethiopia

The Government of Ethiopia has developed and implemented a series of policies, strategies and programmes for various economic sectors. They are: (a) SDPRP, 2000-2005; (b) New Coalition for Food Security (2003); (c) Agricultural Growth and Rural Development Strategy and Programme (2004); (d) Food Security Programme (2004); (e) PSNP, 2004; (f) PASDEP, 2006-2010; and (g) GTP, 2011-2025.

Based on the experience gained in the implementation of PASDEP, the Government designed GTP, a five-year strategic plan, which is aimed at fostering sustainable development in efforts to achieve the Millennium Development Goals through targeted investments in selected sectors. It is hoped that through the implementation of GTP, Ethiopia will be able to transition from a least developed country to a middle-income country by 2025. The federal and regional governments are responsible for implementing GTP with support from

development partners. The different strategies or programmes are guided by a general framework of the country's long-term ADLI strategy, which was formulated in the early 1990s.

The Government has recognized that although climate change adversely affects development, it does present opportunities to transition to a new sustainable development path. These opportunities include leveraging financial resources and technology transfer through ongoing climate change negotiation efforts and development cooperation. To this end, the Government of Ethiopia developed the CRGE strategy, which is intended to contribute to realizing the goals of GTP, 2011-2025 – reaching middle-income status by 2025, while at the same time minimizing greenhouse emissions and ensuring the sustainable use of natural resources. To complement the Government's efforts, the World Bank supported the establishment of the Ethiopia Climate Innovation Center (CIC, 2011) and funded the establishment of FCPF (Ethiopia, 2010a). The implementation of the policies and strategies is being supported by various proclamations and community by laws. The initiatives are complementary and put particular emphasis on creating employment opportunities and enhancing private sector development, as well as industrial and urban development in a way that provides economic, social and environmental benefits.

1. Sustainable Development and Poverty Reduction Programme Plan for Accelerated and Sustained Development to End Poverty, and Growth and Transformation Plan

The implementation of SDPRP resulted in increased pro-poor spending from 28 per cent in the 2000/01 budget to 57 per cent in the 2004/05 budget. Direct budgetary support was partly provided by the donor community. Following SDPRP, PASDEP (2006-2010) was designed to help in efforts aimed at achieving the Millennium Development Goals and associated targets and to provide an overarching policy strategy for reducing poverty and tackling food security. PASDEP comprises eight pillars: (a) building an all-inclusive implementation capacity; (b) a massive push to accelerate growth; (c) creating a balance between economic development and population growth; (d) unleashing the potential of women in Ethiopia; (e) strengthening the infrastructure backbone of the country, including road and communication networks, urban development and expanded water supply for irrigation; (f) strengthening human resource development; (g) managing risks and volatility; and (h) creating employment opportunities. The programme placed particular emphasis on greater commercialization of agriculture and enhancing private sector development, industry, urban development and scaling up efforts to achieve the Millennium Development Goals.

The implementation of PASDEP and GTP has resulted in substantial economic growth and significant progress in social and human development. Between 2005 and 2011, annual average GDP growth of 11 per cent was achieved, with average annual growth rates of 8.4 per cent in the agriculture sector and 14.6 per cent in the service sector (FDRE, 2010c; FDRE, 2010d; Ermias and others, 2011). Public and private investments during the five years in which the PASDEP was being implemented resulted in a substantial increase in physical infrastructure

and human capital, thus laying a foundation for further economic growth and poverty reduction. Furthermore, PASDEP facilitated a 50 per cent increase in rural electrification through private and public sector interventions.

Furthermore, the total volume of major food crop production increased to 221.8 million quintals, resulting from the use of agricultural inputs amounting to 818,050 tons of chemical fertilizer and 1028.4 tons of improved seed applied on 13.45 million ha of cultivable land (GTP, 2010/11). Improving livestock production and productivity is a priority in GTP as part of the livelihoods diversification initiative (GTP, 2010/11). Livestock genetic potential has been substantially improved with the building up of a stock of 438,337 crossbred cattle and 157,801 crossbred milk cows during the same fiscal year 2010/11. With regard to community benefits and involvement, 8,849,000 smallholder farmers, 144,200 pastoralists and 50,350 semi-pastoralists, or a grand total of 9,044,000, have benefited from agricultural extension services. Of these beneficiaries, 30 per cent were female-headed farmer households and 10 per cent were youth farmers.

The rapid economic growth and social development has created a number of new job opportunities in cities and urban areas and thus has contributed to poverty reduction. The urban unemployment rate has declined to 18 per cent. Per capita income has also increased to \$392. The absolute poverty index has declined to 29.6 per cent during 2010/2011 fiscal year, from 38.7 per cent in 2004/2005. Food-insecure woredas in rural areas have been supported through PSNP, which helped to overcome chronic and transitory food insecurity challenges.

With regard to land management and sustaining land productivity, 3,034 thousand hectares of land were applied with organic manure while, soil and water conservation and rehabilitation works have been performed by mobilizing communities.

The aforementioned achievements amply demonstrate that the implementation of PASDEP and GTP has promoted inclusive green growth objectives, paving the way to a green economy transition.

2. Climate-Resilient and Green Economy Strategy

The CRGE strategy compliments GTP in that it aims to triple GDP per capita by 2025 without an increase in the greenhouse gas emissions. It is also targeting to reduce the greenhouse gas emissions of 400 Mt tons projected for 2025 to the present level of 150 Mt ton/yr, a goal that demonstrates the Government's commitment towards low carbon climate-resilient economic development. The CRGE strategy provides key targets for reducing greenhouse emissions and increasing climate resilience in eight key sectors: energy supply; buildings and cities; reduction emission from deforestation and degradation (REDD); soil-based emissions; livestock; transport; industry; and health. Within these sectors, four initiatives have been fast-tracked for implementation in order to immediately promote climate-resilient inclusive growth, capture large abatement potential and attract available climate finance. The four initiatives are: power infrastructure financing, rural energy-efficient stoves, efficient livestock management; and REDD. The agriculture and forestry sectors have been identified as having the largest abatement potential.

The CRGE strategy provides an entry point for promoting inclusive green growth in Ethiopia. The initiative follows a sectoral approach. Out of 60 initiatives, the ones listed below have been identified for fast-track implementation:

- Exploiting the vast hydropower potential and expanding electricity generation from renewable sources of energy for domestic and regional markets.

- Improving efficiency of crop and livestock production practices for enhanced food security and rural household income and promoting the value chain while reducing greenhouse gas emissions.
- Protecting and re-establishing forests, and implementing REDD projects for economic and ecosystem services, such as carbon stocks.
- Enhancing large-scale promotion of advanced rural cooking technologies.
- Leapfrogging to modern and energy-efficient technologies in transport, industrial sectors, and buildings.

The initiatives are investment-ready projects that cover sectors considered to be priority areas by the government, are feasible to implement and can offer opportunities for inclusive green growth and promote the transition to a green economy by 2025 (see table 2).

To implement these initiatives, CRGE units have been set up and concrete proposals have been developed to support such areas as agriculture, industry, transport, water, energy and environment. A CRGE facility for climate finance schemes has been established in the Ministry of Finance and Economic Development, while its implementation is being guided by the Federal Environmental Protection Authority (EPA).

Table 2: Expected social, economic and environmental outcomes of investment projects identified for CRGE implementation

Investment-ready projects	Implementing sector	Economic benefits	Social benefits	Environmental benefits
Power infrastructure financing	Ministry of Energy and Water	Offers GDP increase through export, tariff adjustment, tapping external funding sources Results in fuel cost savings of more than \$1 billion Enables renewable power generation of > 67 TWh	Creates improved and efficient public transportation Enhances technology transfer Improves health and creates an enabling working environment for the labour force Absorbs a large labour force Meets growing domestic demand Offers significant jobs	Reduces greenhouse gas emissions by about 46 Mt CO ₂ e
Industry	Ministry of Industry	Increases cement production from 3 Mt/yr in 2010 to > 65 Mt/yr in 2030; creating value of > \$6.5 billion Increases textile and leather production by fivefold to an amount > \$2.5 billion by 2015 Reduces the volume of fossil fuels import, and increases savings of foreign currency Results in switch from fossil fuels to biomass energy Increases farmers' household income by selling biomass to cement factories	Creates sustainable jobs Improves health Reduces market prices and creates market stability by increasing cement production Creates employment, value added capital formation Enables construction of comfortable and risk-resilient housing due to high volume (per capita) of cement production available at affordable prices	Reduces greenhouse gas emissions by 22 Mt CO ₂ e Creates savings of an average value of about \$50 /t CO ₂ e
Rural energy and efficient stoves	Ministry of Energy and Water	Reaches more rural households, supplying them with efficient stoves Creates \$1 billion savings from fuelwood expenditure and increases rural household income Creates more jobs	Reduces burdens of fuelwood collection on women Improves health and women's empowerment and girls' school attendance	Reduces greenhouse gas emissions by 22 Mt CO ₂ e Creates savings of an average value of about \$50 /t CO ₂ e
Efficient livestock rearing	Ministry of Agriculture	Increases productivity to up to 40 million cattle Creates 1,800 full-time employees Results in saving of \$800 million in the period 2011-2015 and \$10 billion in the period 2011-2030	Offers employment opportunities by boosting the value chain, mechanization etc. Improve the incomes of 17.6 million households by 2030 Reduces child malnutrition	Reduces greenhouse gas emissions by 48 Mt CO ₂ e

Contd...

Investment-ready projects	Implementing sector	Economic benefits	Social benefits	Environmental benefits
REDD, afforestation and sustainable forest management	Ministry of Agriculture	<p>Reduces the rate of deforestation (140,000 ha/yr for fuel and farmland expansion).</p> <p>Distribution of fuelwood-efficient stoves, biogas, electric stoves</p> <p>Covers 4 million ha of afforestation/reforestation etc.</p> <p>Increases household incomes through sales of forest products</p> <p>Increases GDP via wood product import substitutions</p> <p>Increases financing through payment for carbon sequestration and reduced CO₂ emission i.e. carbon trading and environmental services to \$1.2–3.6 billion/yr</p> <p>Generates income from timber and non-timber products by \$3.5 /ha/yr</p> <p>Generates savings/ additional income of \$1.4 billion in the short-term (2015) and about \$16 billion in the long-term (2030)</p>	<p>Supports community empowerment in benefit sharing of forest resources through the implementation of PFM</p> <p>Improves health, women empowerment, etc.</p>	<p>Emission reduction by 130 Mt CO₂e</p> <p>Climate regulation, reduces soil and biodiversity losses</p>
Improve soil management	Ministry of Agriculture	<p>Increases yields via crop residue</p> <p>Applies agri-technologies, small- and large-scale irrigation schemes to create benefits of \$600 million/yr (2011-2030)</p>	<p>Create labour savings from high labour productivity</p> <p>Fosters climate-resilient asset building</p> <p>Ensures women and youth empowerment</p> <p>Increases food security</p>	<p>Reduce greenhouse gas emissions by 40 Mt CO₂e</p>
Electric rail Fuel efficiency standards for vehicles Light rail and bus rapid transit Mixing ethanol and biodiesel	Ministry of Transport	<p>Reduces transport costs and increases foreign currency accumulation through improved trade balance and reduced import of fossil fuels by 2030. Lower transport costs would translate into savings of \$0.03 per ton-km in 2030</p>	<p>When the projects are fully operational, they would provide employment for more than 300,000 citizens, in particular young people, women and girls, who are disproportionately unemployed and underemployed</p>	<p>Reduces emission 19 Mt CO₂e by replacing 280 city buses and 282 other busses and 900 mini buses of diesel driven by electric LRT and RBT</p>

Contd...

Investment-ready projects	Implementing sector	Economic benefits	Social benefits	Environmental benefits
For buildings and green cities: - Transiting to high efficiency light bulbs - Managing landfill gas and liquid wastes	Concerted efforts of Ministry of Water and Energy; city administration; Ministry of Housing and Urban Development	Generates household/ community income	Promote employment opportunities, improve health and environmental safety	Converting landfills into energy sources
Overall benefits		Triples increase in real GDP	Creates more new employment opportunities for the growing population Increases household asset building and food security	Ensure emission reduction of 255 Mt CO ₂ e

Ethiopia commenced implementing many of these initiatives over the last few years as part of GTP. Among those initiatives are the following: construction of large- and small-scale hydropower and irrigation dams; developing solar, wind and geothermal power; dissemination of improved cooking stoves; promoting rural market access and modernizing Ethiopian agricultural marketing through the establishment of the Ethiopian Commodity Exchange; expanding export-oriented commercial farming and the agro-processing industry, such as sugar cane plantation and sugar production; expansion of cement and garment industries; and construction of railways to improve rural and urban public transport systems.

These initiatives have implications for the transition to a green economy, and are an indication of the Government's ambition to make the country a "green economy front runner". Many of the initiatives offer positive returns on investments, such as creating additional jobs with high value added, improving public health through better air and water quality and increasing food security by improving agricultural productivity through improved soil fertility and agricultural practices.

3. Achievements and challenges

The implementation of SDPRP, PASDEP and CRGE has thus far, registered a number of achievements. Among them are:

- Irrigation infrastructure developed to insure smallholder farmers against drought shocks.
- Private sector development and export diversification enhanced to mitigate against trade shocks.
- Farmers' education intensified to enhance labour productivity.
- The marketing system for agricultural outputs and inputs streamlined and strengthened (through commodity exchange system).
- Small and medium enterprise packages formulated and implemented to address women and youth unemployment and underemployment problems.

The challenges included:

- External shocks (skyrocketed international oil prices and financial and economic turmoil); this absorbed a significant share of GDP spent on fossil fuels imports, thus putting pressure on foreign currency reserves.
- High inflationary pressure.
- Capacity constraints in domestic revenue collection.
- Constraints in maintaining quality services in the face of the massive expansion of infrastructure and social services.
- Limited implementation capacity to improve access to and the quality of service delivery.
- GTP and CRGE require massive capital investment for infrastructure development. Estimations indicate that \$50 billion is required for implementing the first five-year plan of GTP and \$150 billion is needed for implementing CRGE during the next 20 years. Current and projected domestic savings, foreign direct investment, grants, and transfers will not be sufficient to finance these project investments, thus leading to significant financial gaps.

C. Case studies

This section contains a discussion on six case studies on inclusive green growth. The studies involve four sectors that are seen as major players in the implementation of GTP and CRGE. They are: agriculture and land management, forestry, transport and energy.

1. Agriculture and land management sector

As stated in the introduction, the economy of Ethiopia is largely dependent on the performance of the agriculture sector, with some 85 per cent

of the population primarily dependent on using land resources, such as soil, water and forests, to meet their basic needs, including food, energy, shelter, water and cash. The sector employs the largest share of the labour force, particularly smallholder farmers, who account for more than 95 per cent of the total food production for subsistence. More importantly, the performance of the agriculture sector, particularly the crop and livestock subsectors, is heavily affected by periodic drought, soil degradation caused by overgrazing and deforestation, and high population density. These factors increase the vulnerability of rural communities to climate change. Since the early 1970s, the performance of the agriculture sector has failed to keep up with the demands of the growing population and during that period land degradation has been recognized as a severe environmental problem and major contributory factor to declining agricultural productivity and livelihoods in Ethiopia. Despite this, the sector is the country's most promising resource with large potential as regards to promoting inclusive green growth and transitioning to a green economy. The following case study, which is discussed in detail, is centred on the Ethiopian agriculture sector.

Case study 1: Sustainable Land Management Project

The Ethiopian Sustainable Land Management project was initiated to reverse the serious level of land degradation by promoting and scaling up the application of successful sustainable land management (SLM) technologies and approaches. It is a comprehensive approach to sustainable land resources and integrated watershed management that entails dealing with interlinked problems of poverty, vulnerability and land degradation at the rural community level by overcoming key barriers, including those pertaining to knowledge and technology, policy, legal issues and institutional, economic and financial matters.

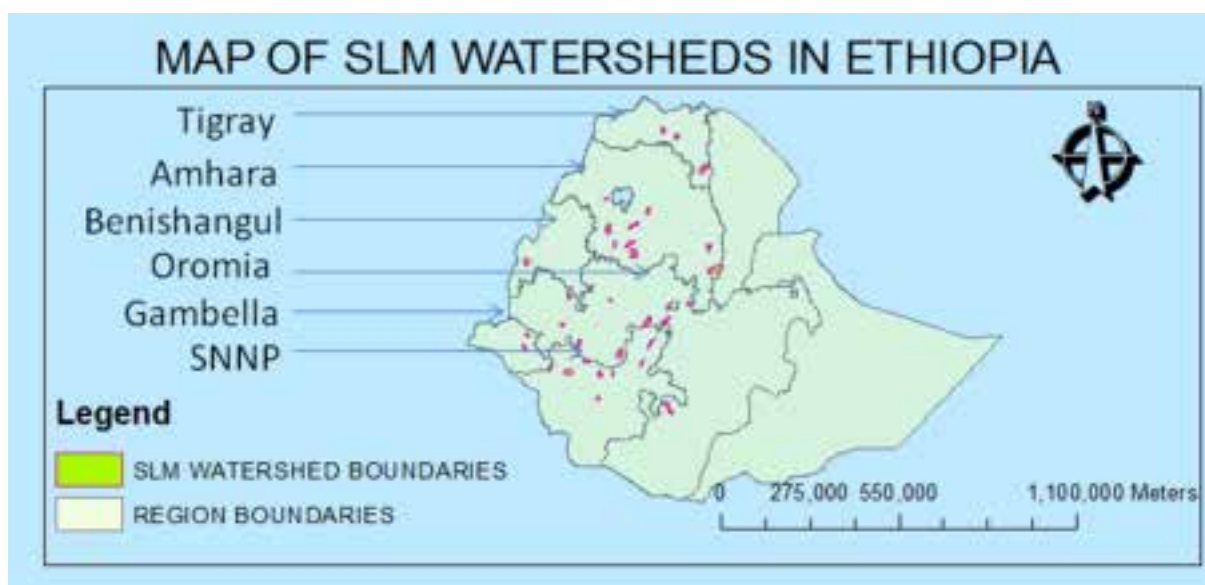
The project, which will run for 15 years (2009-2023), is being funded by a \$6.7 billion grant. Key development partners supporting the project are the World Bank, the World Food Programme, the International Fund for Agricultural Development (IFAD), the United Nations Development Programme (UNDP), the Global Environment Facility, the African Development Bank (AfDB), the European Commission (EC), the United States Agency for International Development (USAID), the Food and Agricultural Organization of the United Nations (FAO), the International Agricultural Research Centres, the Horn of Africa Initiative supported by the governments of Norway, Sweden, Finland and the Netherlands.

A number of programmes and projects for SLM have been implemented, resulting in the introduction of modern technologies in the country (Stahl, 1993; Gebremedhin, 1998; EthiOCAT, 2010). Many of the traditional land management measures that have been practised throughout the country for more than 400 years are considered in the implementation of the SLM project. These include, Konso hillside terracing, crop rotation, long-fallow and tree-crop-mix farming systems (McCann, 1995). Traditional SLM

techniques are practised by local communities in agricultural, pastoral and degraded lands for the purpose of improving land productivity, increasing availability of soil moisture and reducing soil nutrient losses. These techniques enhance climate change adaptation and mitigation, tackle environmental degradation, improve food security, promote private and collective efforts to conserve natural resources and, ultimately, reduce poverty.

The project provides the basis for promoting and upscaling SLM through the implementation of SLM investment projects in carefully selected priority areas. It also has a capacity-building component, which includes developing the SLM knowledge base and creating the necessary enabling policy, legal, institutional and financial environment within those areas required immediate attention. Another component of the project entails harnessing social infrastructure for natural resource management to support community participation and mobilization for labour-intensive physical and vegetated structural and agronomic land management practices at the watershed level in agricultural, pasture and degraded lands.

Figure 3: SLM intervention sites/woredas/watersheds



Source: Sustainable Land Management Program. Available from <https://sites.google.com/site/slmethiopia/slmp-177-upscaling-woredas>,

(i) Objectives, design and implementation

The project is being implemented in 177 woredas in five regional states, Oromia, Amhara, Gambella, Benishangul Gumuz, and Tigray, and in the Southern Nations Nationalities and Peoples' Region, which is referred to in the project as the SNNP region (see figure 3). The World Bank is extending support for 35 SLM intervention watersheds.

The project implementation period (January 2009 - December 2023) is divided into three five-year phases:

- Phase 1: January 2009 - December 2013
- Phase 2: January 2014 - December 2018
- Phase 3: January 2019 - December 2023

The investment funding of the 15-year SLM project comprises two components:

- Current baseline funding: \$1.3 billion
- Incremental funding: \$5.4 billion

Government organizations, local non-governmental organizations (NGOs) and development partners are involved in initiating, implementing and financing the SLM project-related programmes. These include: World Overview of Conservation Approach and Technologies; Centre for Development and Environment of the University of Bern; and Ethiopian Overview of Conservation Approaches and Technologies network. To upscale the SLM technologies and approaches in a well-coordinated and systematic manner, the then Ministry of Agriculture and Rural Development developed the Ethiopian Strategic Investment Framework for Sustainable Land Management, which provides guidance on harmonizing efforts, resources and expertise.

The Ethiopian Strategic Investment Framework for Sustainable Land Management is tasked with setting strategies and directions, providing investment opportunities, and putting in place effective institutional capacity and operational structures for the implementation of the Ethiopian SLM for a 15-year period starting in 2009. The implementation is based on a multilevel cooperative partnership of stakeholders at the federal, regional, woreda, and local/community levels. At the federal level, there is a multi-stakeholder platform comprising a national SLM steering committee and a national SLM technical committee under the auspices of a national SLM secretariat located in the Natural Resources Division of the Ministry of Agriculture and Rural Development.

The steering committee is chaired by the Ministry of Agriculture and Rural Development and has high level representation from the Ministry of Finance and Economic Development, the Ministry of Water and Energy, the Environmental Protection Agency and the Ethiopian Institute of Agricultural Research regional administrations. Also serving on the committees is a representative from each development partner. The steering committee ensures harmonization, coordination and alignment of SLM activities in the country, provides strategic direction and guidance, and sets priorities for SLM programmes and projects relevant to integrated land resources management (soil, water and vegetation).

The technical committee comprises representation of senior technical staff from Ministry of Agriculture and Rural Development, the Ministry of Water and Energy, the Environmental Protection Agency, the Ethiopian Institute of Agricultural Research, the Institute of Biodiversity Conservation and the Ethiopian Development Research Institute. It provides technical and managerial support to the steering committee for the effective implementation of SLM programmes and projects. The secretariat provides logistical and administrative support for day-to-day activities.

At the regional and woreda levels, implementation responsibilities lie with the regional Bureau of Agriculture and the Woreda Office of Agriculture. The regional SLM platform consists of regional counterpart institutions to the steering and technical committees, while the woreda SLM platform, which is supported by a technical committee, is composed of representatives from various stakeholders. The technical committee has overall responsibility for planning, implementing and reporting.

A full monitoring and evaluation system, which tracks performances in terms of financial expenditure, impact of organizational capacity-building, environmental impact, beneficiary impact, participatory monitoring and impact assessment at community level is in place. The project coordination and financial management

(procurement and disbursement) are operated by the office of the SLM secretariat, which is headed by the programme coordinator appointed by the State Minister of the Ministry of Agriculture and Rural Development. At the regional level, the monitoring and evaluation system is operated in the same manner as at the federal level. The regional SLM secretariat, which is housed in the Bureau of Agriculture, runs project coordination and financial management activities. At the woreda level, financial management is the responsibility of the woreda finance office. The overall financial and procurement management is handled by the Ministry of Agriculture and Rural Development at federal level, and by the Bureau of Agriculture at the regional level.

Table 3: Economic analyses of some selected SLM technologies (in terms of gross production value in \$ per hectare per year)

	Name of SLM technology	Gross production value in \$/ha yr ¹	
		Without SLM	With SLM
1.	Stone terraces	100	300
2.	Konso bench terrace	<100	200
3.	Sweet potato ridges	257	450
4.	Crop residue and stone mulch (Konso)	<100	150
5.	Ridge basin (Konso)	<100	150
6.	Chat ridge bund	3000	6000
7.	Area enclosure management	<100	116
8.	Soil bund	160	240
9.	Vegetated <i>faya juu</i>	200	500
10.	Terrace (soil bund and <i>fanya juu</i> on cultivated land)	<100	176
11.	Soil stone bund (vegetated stone-face bunds)	260	400
12.	Stone-faced trench bund	<100	250
13.	Stone terraces	<100	300
14.	Stone bund	200	460
15.	Graded soil bund	150	250
16.	Paved and grass waterways	150	250
17.	Stone-faced soil bund	150	312
18.	Gully control	<100	200
19.	Hillside terraces combined with area closure	100	160
20.	Microbasin with trenches for area enclosure	200	400
21.	Run-off/floodwater farming	200	500

(ii) Expected/realized outcomes and impacts

About 52 technologies and 27 approaches have been documented in EthiOCAT (2010) with detailed definitions and technical descriptions of the technologies. From these, about 35 technologies and eight approaches have been selected for outscaling (see table 3).

These approaches include, among others, physical land management practices (stone bands and terraces, soil bunds), vegetated structural land management practices (perennial crop strips, area closures, vegetated *fanya juu*, broad-basin ridges and multiple cropping), hillsides and gully rehabilitation, run-off-water harvesting, grazing land management, agroforestry systems and vetiver hedge. The implementation of SLM interventions since 2001 has resulted in several economic, social and environmental outcomes.

Economic impacts

The economic benefits obtained from the project arise from soil fertility improvement, soil moisture retention and water availability. These outcomes have led to greater agricultural productivity and an increase in the income of participating farmers who adopted SLM technologies (see table 3). Generally, the economic returns of farmers that used SLM technologies was twice as high as what was attained by farmers that did not use the technology. Gebremedihin and others (2009) evaluated economic outcomes of some SLM interventions, including grazing land management, forage development and conservation tillage, in three districts located in the Amhara Regional State (Bure, Fogera and Metema districts) and one located in the Tigray Regional State (Atsbi-Womberta District). The findings indicated that forage development intervention led to the production of more than 100 ton forage with three harvests per year. This provided annual income of 18 to 21 million Ethiopian birr (Br) (\$900,000 – 1.1 million) from fattening livestock, dairy, beekeeping, high-value vegetables and forage crops.

Environmental impacts

Regarding environmental impacts, the interventions resulted in spring development, increased vegetation cover, decreased run-off and soil loss, reduced downstream flood hazards, enhanced soil rehabilitation, reduced downstream sedimentation, increased soil fertility, increased stream flow during the dry season, increased water infiltration and ground water recharge. Additionally, the intervention minimized the spread of invasive species. For example, *Hygrophilla auriculata* (Amikela), an invasive thorny weed species has been cleared from 268 grazing lands in Fogera District during forage development. Furthermore, the intervention promoted the growth of palatable forage species, legume species and indigenous bee forage perennial plants, thus increasing honey bee colonies.

Social impacts

Sustainable land management practices have enhanced social protection and gender equity in the watersheds where they have been implemented. For example, in Ethiopia, male-headed households usually own more livestock than female-headed households, and in the free and uncontrolled grazing systems, female-headed households do not benefit as much from grazing lands. In SLM intervention watersheds, female-headed households receive the same benefit as male-headed households in the form of conservation tillage, cut-and-carry systems, access to credit for water harvesting structures and other SLM activities. Furthermore, the female-headed households can either sell their forage and crops in cash, or in exchange for traction power for plowing and threshing. The system also provides schools as an incentive and frees children from huge workloads, including fuelwood collection and water fetching. The project provides opportunities for farmers to grow new crops and gives them free time to pursue other income-generating activities, such as cattle rearing, sheep fattening, poultry, beekeeping and raising fruit seedlings for sale.

(iii) Cross-cutting issues

The increased groundwater recharges and downstream flow are good production assets for irrigation during drought years. Expanding farmers' knowledge of SLM technologies and soil and water conservation measures, as well as growing new crops and controlling invasive species, would increase adaptive capacities of the farming communities to the impacts of climate change. The project has also promoted indigenous agroforestry, conservation tillage and vetiver grass-hedge planting. For example, the SLM interventions in Benishangul Gumuz and Gambella regional states have dealt with such management issues as loss of natural vegetation cover and declines in wetland ecosystem and wildlife habitats, which would eventually be integrated into the programme of flood disaster risk reduction facility in the region.

Following the devastating floods in Dire-Dawa, a run-off and flood-water farming system has been established as an integrated approach to manage flood waters for building productive assets through irrigation and flood control schemes. The project has promoted the upscaling of indigenous technologies that have economic, social and environmental benefits. For example, the Konso

Figure 4: Konso cultural landscape: stone wall terraces on steep slopes



Source: www.tourismethiopia.gov.et/English/Attractions/Pages/konso.aspx.

Bench Terrace and Konso Ridge Basin are traditional SLM practices that have evolved from many years of land use practices (see figure 4).

As one can see, the stone wall terraces have very open tree canopy. Therefore, high value perennial crops such as fruits trees need to be planted on the stone wall terraces to reduce soil erosion and boost the amount of water that reaches the lower slopes. Also, the communities need to have bylaws for keeping these traditional technologies, accessing financial support from credit arrangement schemes and ensuring the fair and equitable distribution of benefits from UNESCO.

The technologies are suitable for minimizing crop failure caused by insufficient rainfall, and stabilizing soil erosion on steep slopes. The Konso Bench Terrace technology, which has been practised for more than 500 years, is still being applied. The technology of stone walls supported by trees forms an integral part of the Konso Cultural Landscape and is registered as a UNESCO World Heritage Site. It is traditional, easily understood and often demonstrated to farming communities across the country, thus constituting technology transfer in the local context. It creates sustainable employment and enhances food security and access to the emerging ecotourism market. The SLM interventions promote community empowerment by strengthening capacities of local communities and government institutions. This gives women and young people a greater voice in decision-making through participatory planning, designing and the implementation of SLM projects.

(iv) Sustainability and replicability

The project was developed through collaborative efforts of the Government and development partners. It places particular emphasis on mitigating serious ecological threats posed by land degradation, alleviating rural poverty and food insecurity and tackling the negative impacts of climate change. Considering sustainable land

management as the basis for transformation in the agriculture sector, the project promotes strong cooperation and collaboration among participating government ministries and institutions at the federal, regional and woreda levels, as well as in the donor community. All of the partners have devoted considerable technical and financial resources to institutional capacity-building and technology development. The capacity-building and database management component of the project ensures the provision of facilities, skills and training on SLM to land users and extension agents. The economic gains realized are expected to spur investment (cash, labour and land) by the private sector engaged in small- and large-scale commercial land ventures. This, in turn, will contribute to ensuring the sustainability of the project and its replication within and outside the SLM watersheds.

(v) Lessons learned

The lessons drawn from the implementation of the SLM interventions include:

- Extensive community mobilization helped in enhancing the scaling out of local technologies that have been in use for generations.
- Construction of schools, health centres and roads served as incentives for community participation, thus fostering forest development and natural resource conservation and management.
- Land regulation and provisions that provided land certification ensured long-term land use rights, which encouraged sustainable land resource management.
- Documentation, popularization and awareness raising of traditional SLM practices/ technologies and their impacts created sustainable development and food security through accessing the emerging ecotourism market and climate finance, as in the case of

the Konso Cultural Landscape, which is registered as a UNESCO World Heritage Site.

- Integrating national and regional field visit programmes as part of SLM project activities were instrumental in promoting technology transfer in the local context, as farmers easily adopted technology through experience sharing and impact observation.
- The SLM interventions were instrumental in promoting community empowerment. Being participatory at the planning, designing and implementation phases, they gave women and young people a greater voice in decision-making, which, in turn, promoted social and gender inclusiveness in the drive to achieve inclusive green growth.

2. Forestry Sector

Despite limited coverage and continued degradation of forest area, the contribution of the forestry sector to GDP is as high as 9 per cent (Nune and others, 2010). Studies indicate that the direct economic benefits of wood and non-wood forest products amounted to a range of \$1.2 billion to 1.5 billion (about 10.5 billion) per annum between 1999 and 2005. Annual revenue of \$466 million was from the export of non-wood forest products, including forest coffee, gums and resins, honey and bee wax, herbal medicine, bamboo, spices, and civet derived from the high forests and woodland areas of the country (Lemenih, 2008).

Regarding social benefits, forests and woodlands provide wood and non-wood products to small and medium-sized wood-based cottage industries and factories. These enterprises account for 6 per cent of the work force and contribute significantly to the country's tax revenue (CSA, 2004). Many of the micro businesses supported by government programmes are run by young people and women. For example, there are about 737 privately owned carpentry shops in Addis Ababa alone

that produce or sell furniture, building materials, coffins and wood sculptures. This number has probably increased significantly over the years given the government policy of supporting urban youth to be engaged in employment-generating schemes and the construction of large housing projects that require wood and wood products.

However, the potential of youth-employment schemes and the ecotourism industry are threatened by the unsustainable use and management of Ethiopian wood resources. This stems from inadequate institutional capacity, loss or lack of a long-term forest information database and high staff turnover due to frequent institutional restructuring.

The figures on employment opportunities (table 4) show the role of the sector in social protection through job creation and expansion of investment opportunities. The forestry sector also promotes the sustainable development of the agriculture sector.

The direct contribution of the forestry sector to sustainable agriculture is through substitution of crop residues and cow dung by woody biomass to meet the energy needs of rural people, and using the crop residues and cow dung as fertilizer. For example, replacing Urea fertilizer of 100 kg/ha with cow dung with an estimated fertilizer replacement value of 11 kg area, 54 kg DAP, and 8.3 kg potash would lead to a saving of 4,658 Br (\$240)/ha considering the current average fertilizer cost of 7 Br (\$.36)/kg. In addition, nutrients in dung, which are in the form of organic substances, improve the soil structure and the water and nutrient retention capacity of soils, while at the same time reduce green gashouse emissions

from soils. For countries, such as Ethiopia, that have a high livestock population and whose people use marginal soils for crop production and cannot afford to purchase chemical fertilizer, the importance of maximizing the organic fertilizer value of dung cannot be overemphasized.

Traditional farming systems of open cereal cultivation have resulted in loss of forest cover and a decline in carbon stocks in the agricultural landscape, as highlighted in section 2.3. The Government of Ethiopia has committed to tackling deforestation and forest degradation, as an integral component of GTP and CRGE. The current decision to create a ministry of forestry is a concrete example of this commitment. Development partners, such as the World Bank, have supported the institutional reforms by financing the implementation of REDD+ strategies through FCPF.

Five forest management practices that contribute to realizing the goals of GTP and CRGE in forest development are commonly practised in Ethiopia. They are:

- Participatory forest management (PFM) is aimed at dealing with socioeconomic issues, such as improving livelihoods, rights of access to and control of forest resources, local governance and social justice. A total of more than 750,000 ha of forest land has been established under the PFM scheme by various NGOs and development partners (FARM AFRICA, the Japan International Cooperation Agency (JICA), German Agency for Technical Cooperation (GIZ) and SOS Sahel).

Table 4: Contribution of the forestry sector to employment

Employment sector	Number of employees	Sources
Fuelwood supply to Addis Ababa	15,000-20,000 women and children	Haile (1991)
Gum and incense	20,000-30,000 seasonal workers	Haile (1991)
Selling medicinal plants/herbs	80,000 traditional healers	Lemenih (2008)

- Area enclosure is aimed at enhancing forest recovery and regenerating degraded landscape. This is extensively practised in many parts of the country, including in about 700,000 ha in Tigray and in several thousands of hectares in other regions (Lemenih, 2012).
- Farm forestry promotes small-scale woodlots for household income generation of small-holder farmers.
- Forest carbon financing projects are aimed at enhancing payments for tree planting through forest carbon trading.
- Forest enterprises are aimed at developing high-value commercial timber plantations that promote the establishment of self-financing forest institutions to administer, develop and utilize forests and associated land resources in a sustainable manner.

The aforementioned forest management practices have the potential to support the country's efforts in combating climate change, promoting inclusive green growth and transitioning to a climate-resilient green economy. For the purpose of showcasing inclusive green growth good practices in the forestry sector, PFM has been selected for three reasons: (a) is already widely practised across the country; (b) has produced good practices useful for climate change mitigation and livelihoods improvement; and (c) has been prioritized in CRGE as having great potential to promote the transition to a green economy.

Case study 2: Participatory Forest Management

Participatory Forest Management (PFM) is a forest management system that was introduced as a complementary mechanism to safeguard forests while respecting traditional users and including them in the process (Winberg, 2010). The system's general and common component is its focus on community participation in forest management. This includes agreeing with government institutions or landowners on management plans and the sharing of responsibilities, costs and benefits between a given community and landowners. With this understanding, PFM was first introduced to Ethiopia 13 years ago by FARM Africa, GTZ, JICA and SOS Sahel, as reported by various sources (Kelbessa and De Stoop, 2007; Andargachew, 2009; Bekele and Bekele, 2005).

This forest management practice is aimed at improving forest productivity and the efficient use of forest resources, securing use rights for communities and developing a sense of ownership, developing an appreciation of the livelihood needs of various interest groups and building the institutional capacity and awareness of stakeholders. The approach is used as a mechanism to protect the remaining natural forests by dealing with problems related to open access to forest resources, and enhancing the livelihoods of communities that use and benefit from them. There are many reasons for introducing PFM to Ethiopia (Winberg, 2010). The two main ones are for environmental and social reasons. The first one emphasizes mitigation of biodiversity loss, forest degradation and deforestation while the latter one relates to a concern for livelihoods in forest-neighbouring areas, as well as the rights to utilize forest resources legally. These are closely interlinked.

(i) Objectives, design and implementation

The majority of the PFM intervention sites are located in the south of Oromia and in the SNNP region (see figure 5).

Figure 5: Location of PFM projects in Ethiopia



Source: Winberg (2010)

The largest pockets of remaining natural forests of Ethiopia are located in these regions. The main reason for the introduction of PFM in these natural forest areas is the degree of threat to the forests and the high level of external pressure on them. Other reasons are to provide watershed protection and the commercial value of timber and non-timber forest products. A small number of sites are located in Amhara in northern Ethiopia.

Until recently, the majority of the forests used in PFM projects in Ethiopia have been highland forests. The most frequently represented forest types in PFM are afro-montane and moist forests: Chilmo, Adaba-Dodola, Belete-Gera, Masha and Bonga. More lowland forests in Yableo, Liben, Mojo and Arero have recently been included in the projects (Andargachew, 2009). The ultimate goal of these projects is to promote sustainable forest management through community participation facilitated by the devolution of property rights from the state to the community and to enable local communities to manage and utilize forest resources sustainably. The underlying principle of the projects is to balance forest resource conservation and utilization by empowering communities to take over forest management responsibility. The PFM process entails a partnership between the government and communities in the preparation and implementation of the programme with clearly defined roles, rights and responsibilities of both parties specified in legal documents.

The number of organizations or forest user groups are estimated to be about 369 (table 5). This estimation gives an indication of the large number of people involved in PFM in Ethiopia. In a review of PFM practices and experiences in Ethiopia, Winberg (2010) reported that the number of households involved was about 30,000.

Table 5: Area of forests and farmers’ user groups under PFM in Ethiopia

	PFM Actors					Total
	FARM/SOS	GIZ	JICA	NFTP-South West	FARM/SOS followed by Coffee Union and FAO	
Area (ha)	126 201	289 000	89 191	11 018	31529	546 939
Region	Oromia	Oromia	Oromia	SNNP	SNNP	
User groups	64	122	127	7	49	369
Forest site	Chilmo/ Liben/ Arero/ Yabelo/ Bale	Mojo/Adaba- Dodola	Belete-Gera	Masha	Bonga	

There are a number of investments and corporate activities in PFM project areas and their vicinity, which in most cases involve coffee and tea plantations. In the PFM forests in the lowlands, companies are also involved in collecting incense and gum. These commercial activities provide seasonal job opportunities to local communities.

The PFM activities include growing plantations, reforestation or rehabilitation of degraded lands; forest protection and utilization; monitoring of the forest and evaluation of the management approach. Forest management activities are often aimed at improving livelihoods and biodiversity. Important components of the PFM implementation include the introduction and creation of forest management associations, community-based organizations or cooperatives and transferring ownership to participating communities.

Regarding monitoring and evaluation, the importance, effectiveness and the activities of actors are discussed by the stakeholders. Through the monitoring and evaluation process, it is possible to assess performance, adjust the management plan as necessary and make informed decisions on benefit sharing. The process is conducted in different ways. The first is participatory monitoring by communities, which is preferred by many PFM actors in Ethiopia, as it demonstrates trust in these communities. However, a concern associated with it is the difficulty in controlling the procedure and follow up on the results when it is carried out by communities. The second type is carried out by representatives from both government and the PFM community organizations. In the third type, the government and NGOs share the responsibility for monitoring. The government officer, who carries out the monitoring, is expected to be trained in forest management. The community representative is expected to demonstrate knowledge of the value of the forest resource. In addition, monitoring activities have financial implications, which is also discussed and agreed by all stakeholders. In most cases, the cost

is covered by stakeholders, such as the initiating organization, the government or by a donor. The time intervals that monitoring is carried out differs from stakeholder to stakeholder. The following illustrate this:

- Communities patrol the forest daily and every second month government representatives patrol.
- Woreda official and NGOs monitor every month.
- Development agents and community representatives patrol every six months.
- Community and regional governments patrol every three to five years.

The important reasons for monitoring is to allow the adaptation of the management plan and the evaluation of the PFM.

(ii) Expected/ realized outcomes and impacts

The PFM activities have registered beneficial social, economic and environmental outcomes, particularly with regard to NTFP and ecosystem services. Among them are the creation of environmental awareness, the enhancement of household incomes and the availability of alternative livelihoods.

Economic impacts

Introducing PFM in communities adjacent to forests in general has considerable positive impacts on their livelihoods (Winberg, 2010). An important positive impact relates to secure access by households to NTFP, resulting in enhanced utilization, improved marketing possibilities and an increase in household incomes. In coffee-growing areas, only coffee, honey and spices offer significant contribution to incomes. In those areas, the reliance on coffee for income generation is high, up to 80 per cent.

Social impacts

The PFM process deals with social issues, such as securing use rights, ownership and gender equity. In most cases, the contractual agreements signed between the forest user groups/forest cooperatives (FUG/FCs) and FCs and the government widely reflect communities' rights. However, in some cases, the agreements are skewed in favour of the government, leaving the possibility for repossession of forests by the government when found necessary. It is worth noting that communities are involved in preparing these legal documents and that they are secure in knowing that as long as they protect and manage the forests, they will retain and exercise full use the rights indefinitely. Benefits derived include access to fuelwood, construction materials, controlled grazing and bee keeping, which provide alternative livelihoods. In addition, PFM fosters a sense of ownership, confidence and trust in government.

The PFM process also promotes social and gender equity and equality through the equal participation of marginalized groups and women. Both husbands and wives are equally considered as members of the forest user group and in instance of polygamy, wives are considered as independent members. Women also occupy leadership positions. However, in some cases, as in the Bonga and Chilmo forests, illiteracy and culture limitations restrict the ability of women to lead (Bekele and Bekele, 2005).

The negative social impact of PFM is in the form of social discrimination between PFM members and non-PFM members. The collection of NTFP, such as coffee and various spices, for cash generation was commonly practised by communities before the demarcation of the PFM project. Following the demarcation, the rights of collecting economically useful NTFPs were transferred from individual farmers to forest user groups or member communities. This denied individuals access to all forest goods and services, including commercial wood and coffee, and

thereby resulted in antipathy towards the project. In addition, farmers willingly have given up their traditional rights of unlimited access to the forests in anticipation of livelihood diversification strategies and other benefits. However, at times, they fail to receive credit facilities that would have contributed to enhancing their livelihoods, which often results in mistrust between communities and project developers.

Environmental impacts

The most important environmental impact relates to ensuring the survival of healthy and productive forests. As a result of PFM, a forest gains some degree of protection from the community, reversing degradation through natural regeneration and the planting of indigenous species. This improves the forest quality and forest services in terms of recovering biodiversity, higher seedling survival and improved water quality. Another positive impact of PFM is the rehabilitation of degraded land through tree plantations and area closure following the introduction of PFM. In addition, the process limits or brings to a complete halt forest resource extraction activities, such as timber harvesting and tree felling for charcoal production.

(iii) Cross-cutting issues

The improved living conditions brought about by PFM have translated into improved health, eradication of malnutrition and increased access to agricultural technologies and credit services. Studies by Bekele and Bekele (2005) confirmed that PFM in Chilimo has resulted in the dissemination of agricultural technologies to selected members of forest user groups/FCs. These included technologies that promote major income-generating activities, such as vegetable, poultry and sheep production, as well as improved crop varieties.

The technologies are transferred directly or facilitated through credit services that enable communities to purchase improved seed varieties

in order to diversify their sources of income. The increased income enables them to boost household consumption, repay their debt and purchase sheep or other livestock for rearing. Communities are also trained in bee and poultry keeping, and seed collection and handling, further diversifying their sources of income.

The PFM projects enhance climate change mitigation efforts by reducing greenhouse emissions from deforestation and forest degradation, which augurs well with the objectives of CRGE and GTP. Communities in non-forested areas are encouraged to plant trees individually or collectively to be able to benefit from REDD and the Clean Development Mechanism (CDM) project opportunities. In this regard, the Bale Eco-Region Forest Project is considering the incorporation of REDD and climate change adaptation into its PFM strategy. The move towards scaling up of PFM projects to explore REDD+, CDM and voluntary carbon markets will promote the self-financing of PFM projects. The income derived from carbon trading can be used to fund management activities and provide further incentives to communities to manage their forests sustainably. In this respect, forest carbon management, payment modalities and measurement, reporting and verification (MRV) systems are in the process of being tested in selected PFM projects.

(iv) Sustainability and replicability

The results achieved from the productive partnership between the government, communities and development partners have been instrumental in motivating all actors to engage in more PFM projects. The government and development partners have continued to provide technical and financial support while the communities have demonstrated further commitment to PFM projects. Furthermore, political commitment and favourable policies have facilitated the dissemination of PFM to

various parts of the country, including the handover of state-owned natural forest resources to communities. In addition, the current PFM project sites serve as field schools for experience sharing among communities. This promotes the transfer of knowledge and skills that encourages more communities to engage in PFM projects. Notably, PFM projects are being extended to Oromiya and SNNP regions and, to some extent, in Amhara. Projects will also be introduced for the first time in the Benishangul Gumuz region.

(v) Lessons learned

Lessons learned include:

- Involving all stakeholders from the beginning facilitated the successful initiation and implementation of the projects.
- Making use of and strengthening traditional systems such as consultation and consensus building among the different stakeholders local elders, politicians and religious leaders, as well as the recognition of traditional knowledge and customary rights were instrumental in the success of the projects.
- The awareness component of the project helped in creating an understanding on the importance of the PFM approach for the conservation of forest resources. This brought about a significant attitude change that contributed to the success registered.
- Linking sustainable forest management to improving access to NTFP, improved marketing of products and income generation was instrumental to community buy-in.
- The initiative to consider marginalized groups and women as equal partners and independent individual members of the forest user groups helped in promoting social inclusion and gender equality.

- The field tours and exchange of experiences between farmers and communities at different PFM sites proved to be beneficial to the replicability of PFM projects.

3. Energy sector

In Ethiopia, biomass fuel accounts for 91.5 per cent of the country's total energy demand, with the remaining 9.5 per cent by imported petroleum (7.4 per cent) and electricity supply (1.5 per cent) (FDRE, 2011). Imported petroleum accounts for 40 per cent of total imports and absorbs 60 per cent of export earnings. Petroleum and electric power are major sources of energy for the transport and industry sectors. In the housing sector, energy demand is met by off-grid fossil fuels (diesel generator and kerosene lamps). Greenhouse gas emissions from these energy sources are projected to increase substantially as the population and economy continue to grow. Presently, the energy sector contributes about 12 per cent of the greenhouse gas emissions.

Within the energy sector, the major sources of greenhouse gas emissions are transport, power generation, industry and housing, each contributing 3 per cent. Industry sectors are expected to grow at a rate of 20 per cent per year. Correspondingly, industrial emissions are projected to grow from 4 Mt CO₂e in 2010 to 71 Mt CO₂ in 2030, with the cement industry being the largest industrial emitter. Transport emissions, which are expected to grow from 5 Mt CO₂e in 2010 to 40 Mt CO₂e in 2030, are driven by emissions from freight transport (+13 per cent per year) and passengers' transport (+9 per cent per year). Regarding housing emissions, urban population growth increases waste generation and off-grid energy consumption. In this respect, buildings-related emissions are projected to increase from 5 Mt CO₂e in 2010 to 10 Mt CO₂e in 2030, with about 25 per cent of the emissions in 2030 forecast to be related to off-grid energy consumption and 75 per cent to waste. Electric power emissions

are projected to remain below the 2010 level of 5 Mt CO₂e in 2030 while total power demand is projected to grow from 4 T Wh in 2010 to more than 75 T Wh in 2030.

Given rising oil prices, higher volatility in the market could constrain socioeconomic development. To counteract the increasing contribution of greenhouse gas emissions, the Government has encouraged renewable energy sources as a way to contribute to the country's poverty reduction efforts and spur climate-resilient and sustainable social and economic development through GTP and CRGE strategies. The strategies are aimed at promoting renewable energy (hydropower, wind, solar, geothermal and biomass) for the green economy. Meanwhile, within the transport, industry and building sectors, there are believed to opportunities to leapfrog to modern and energy-efficient technologies that are capable of mitigating the increase in greenhouse emissions. The energy management strategy of CRGE is aimed at ensuring energy security by diversifying energy sources for import substitution. This approach lowers exposure to the price volatility of international oil markets and enables countries to preserve some of the scarce foreign exchange, which could be invested in job creation and carbon trading projects. In this respect, the Ethiopian Electricity Power Company (EEPCO) plans to switch off current diesel power plants and off-grid generators during the period 2012-2014 and use power generation from renewable sources as from 2015.

To achieve this plan, an energy policy and strategy that focuses on rural electrification, was issued by the Ministry of Mines and Energy in 1995. The policy is aimed at ensuring a reliable supply of energy at affordable prices for rural and urban residents in order to support the agricultural and industrial development strategies. The policy also emphasizes the development and utilization of alternative energy sources with the objective of attaining energy self-sufficiency, while at the

same time, reducing reliance on the natural woody biomass resource base.

The core objective of CRGE is to increase the share of renewable energy sources in the total energy generation, as well as to upgrade technologies to more energy-efficient technologies by 2030. This is expected to reduce fossil fuel use and contribute to the global effort to reduce greenhouse gas emission by abating about 250 Mt CO₂e by 2030. When compared to the current conventional development path, this will lead to a decrease in greenhouse gas emissions by up to 64 per cent in 2030. In line with the drive towards achieving the greening of the energy sector, the Ministry of Water and Energy through EEPCO and the Ministry of Transport are implementing key intervention measures in the transport, industry and building sectors. These include: promoting clean power exports; clinker substitution; biomass usage and waste heat recovery; construction of electric rail and bus rapid transit systems; mixing ethanol and biodiesel; exploiting the vast potential of hydro-, geothermal-, wind and solar power; and introducing fuel-efficiency standards for vehicles.

Furthermore, in the energy infrastructure development plan, EEPCO plans to generate power exclusively from renewable energy sources (on average about 90 per cent from hydropower, 6 from geothermal energy and 4 per cent from wind) and to ensure more reliable and secure energy supply throughout the country. According to EEPCO (2006), Ethiopia has an estimated hydropower potential of 45,000 MW, a geothermal potential of 10,000 MW and an estimated 1.3 million MW from wind.

The Ethiopian Electric Power Corporation is planning to implement different wind power projects in several parts of the country with the aim of complementing the country's hydropower-generating capacity when hydropower resources are at their lowest capacity during the dry season or during droughts. Recently, three wind power plants have been completed and are fully

functional. They are: (a) Adama Nr.1 and Nr.2 wind powers launched in 2009 and now operational with a capacity of 51 MW; and (b) Ashegoda wind farm launched in 2008 with a capacity of 120 MW. The plants have been incorporated into the national power grid. Following the completion of the Ashegoda and Adama wind farm projects, six more wind power projects have been announced, the 300 MW Aysha Wind Farm near the Djibouti border, the 100 MW Debre Birhan Wind Farm north of Addis Ababa, the 100 MW Assela Wind Power Project south-east of Addis Ababa, the 153 MW Adama II Wind Power Project, the 250 MW Galema I Wind Power Project and the 42 MW Mesebo Harena Wind Farm. The German finance company, Deutsche Unternehmensfinanzierung, will raise \$120 million to finance the construction of the first 60 MW of the Aysha Wind Farm Project. When all these projects are completed by 2018, Ethiopia would have a power-generating capacity that exceeds 1116 MW from wind power.

Geothermal energy will be used to complement hydroelectricity and wind power in reducing the country's vulnerability to erratic weather conditions and oil price volatility. Accordingly, along the Ethiopian Rift Valley, the geothermal energy potential of 14 sites, Dalol, Tendaho, Abbe, Teo, Danab, Meteka, Dofan, Fantale, Kone, Gedemsa, Tulu Moye, Aluto-Langano, Corbetti and Abaya, were considered. Most of the identified geothermal sites are within proximity to the national grid. From these potential geothermal sites, only one, at Aluto-Langano, has been exploited thus far for power generation. The site has a capacity of about 7.3 MW, but plans are in the works to increase the output to 70 MW by 2015. The Aluto-Langano geothermal plant is being built with \$12 million of financial assistance from the Government of Japan, \$13 million from the World Bank and a \$10-million contribution from the Government of Ethiopia.

The following section presents three good practice case studies in the energy sector that have a bearing on inclusive green growth. They are:

- Ethanol-Burning Clean Cooking Stove Pilot Project.
- National Biogas Programme.
- Hydropower Development Project.

Case study 3: Ethanol-Burning Clean Cook Stove

Mengesha (2008) describes an ethanol-burning clean cook stove as being a non-pressurized stove with a special fibre-filled fuel canister in which ethanol is adsorbed in the canister's ceramic fibre so that it cannot spill, allowing it to evaporate from the canister into a combustion chimney in which the alcohol burns as a gas, similar to LPG or natural gas. The three-year pilot studies on clean cook stoves in Ethiopian homes showed that one measure of ethanol fuel displaced at least one measure of kerosene fuel, even though kerosene has a 43 per cent higher energy content than ethanol, which can be attributed to the 74 per cent higher operating efficiency of a clean cook stove when compared to a kerosene wick stove. Thus, a clean cook stove can displace imported kerosene for cooking on an equal measure basis; this is highly significant for import substitution, given that the Ethiopian urban household cooking sector is kerosene-dependent and is the second largest consumer of fossil fuels after the transport sector. The replacement of kerosene stoves with clean cook stoves can solve the acute shortage of energy and reduce household expenditure on fuelwood, particularly in rural areas where access to electric power is limited.

(i) Objectives, design and implementation

The Gaia Association introduced the clean cook stove for household energy use in Ethiopia. Prior to offering it, the Association conducted pilot-testing of ethanol and ethanol-burning clean

cook stoves in different settings. The pilot testing, which took place in more than 500 households in Addis Ababa, 300 homes in refugee camps and 30 institutions, amply demonstrated the efficiency of the clean cook stove, which was redesigned for the Ethiopian market to take into account affordability, give it greater strength and larger pot capacity and accommodate round-bottomed pots. After been evaluated with the 5L standard testing pot at the Aprovecho Research Centre in Oregon in the United States of America, the stove was found to be fuel efficient and have low emissions. The Gaia Association has conducted indoor air pollution monitoring tests in homes in Addis Ababa and at refugee camps throughout Ethiopia following the indoor air pollution protocols outlined by the University of California, Berkeley. The measurement of carbon monoxide and particulate matter concentrations in the cooking room showed that the clean cook stove technology is clean.

(ii) Expected/realized outcomes and impacts

The clean cook stove was introduced to improve efficiency, enhance affordability and reduce the health impacts associated with cooking using existing technologies.

Economic impacts

Many city administrations and real estate companies are building condominiums and apartment houses throughout the country, particularly in Addis Ababa and other capital cities of regional governments. Given their affordability, efficiency and safety record, clean cook stoves are in high demand in these residential areas, as residents are not allowed to use the cheaper, but dangerous biomass fuels in their homes. The Gaia Association and its business partners are exploring the possibility of making the clean cook stove affordable to low-income households by selling the carbon emission offset resulting from replacing charcoal, fuelwood and kerosene stoves.

Social impacts

The clean cook stove technology is much healthier to use compared to biomass fuel, which emits high concentrations of pollutants, such as carbon dioxide and particle matter. Women using a clean cook stove no longer need to collect firewood for cooking, which is tedious and time consuming. The technology protects women and girls from the possibilities of injury, assault and rape associated with walking long distances in search of fuelwood. The significant time saved is used for more productive activities, such as child care, education and income generation.

Environmental impacts

The technology replaces fuelwood cooking stoves, resulting in reduced deforestation. For example, the pilot study showed that prior to the introduction of clean cook stoves, a household in the Kebribeyah refugee camp was using an annual average of 3,689 kg fuelwood for both cooking and baking. Since the introduction of clean cook stoves, the need for firewood has been reduced, which translates into a reduction of 6,751 kg CO₂e per household per year.

(iii) Cross-cutting issues

The introduction of the technology is directly linked to climate change mitigation and improved health, as it reduces household carbon dioxide emission and provides the opportunity to enhance ethanol production from sugarcane products to supply clean cook stoves in rural and urban areas. Given the rising cost of kerosene and the increasing volatility of the market, these stoves stand to contribute to the country's efforts to reduce poverty and improve health. Following the Biofuel Development and Utilization Strategy (Ethiopia, 2008), the Government allocated 20 per cent of the country's land for biofuel production. From the allocation, 700,000 ha of irrigable land has been allocated for sugarcane plantations for ethanol production, benefiting farmers and the private sector (Alebachew, 2009). The technology

ensures energy security and improves livelihoods through diversification of energy sources and income-generation activities. The import substitution lowers the country's exposure to the price volatility of fossil fuels and enhances foreign exchange savings for investment in job creation and carbon trading projects.

(iv) Sustainability and replicability

Since its introduction, the technology has gained wide acceptance in high- and low-income households throughout the country, mainly on the back of its efficiency, affordability and safety record. Currently, demand for the stoves is high, especially from the condominium residents of Addis Ababa. Regarding financial sustainability, in addition to its high potential for income generation through carbon trading schemes, Makobu enterprises is exploring the possibility of microfinance schemes to enable as many households as possible to switch from kerosene and wood/charcoal-burning stoves to clean cook stoves. The technology has a proven safety record, which is an important priority for households. In addition, the different components of the technology can be produced locally, thus increasing the chances of replicability and sustainability.

(v) Lessons learned

The most important lessons learned from the clean cook stove project is that conducting pilot research with effective stakeholder engagement is very important for sustainable supply and the dissemination of new technologies, as well as for sustainability. The pilot testing showed the social, economic and environmental benefits of the technology to the communities that participated in the research. Additionally, the clean cook stove is being sold to owners of newly built condominium houses in which the majority of the residents are middle-income families and burning

cheaper biomass fuel is not permitted. The factors have facilitated the upscaling of the technology and helped in convincing the Government and other stakeholders to support the outscaling of the project.

Case study 4: National Biogas Programme

The Government of Ethiopia, as part of the GTP and the CRGE strategies, is establishing a renewable energy source expansion programme, which is aimed at expanding biogas digester use by 70,000 units by 2015 (Ethiopia, 2010c; Ethiopia 2010c). The Government, with financial and technical support from SNV Ethiopia, launched the National Biogas Programme Ethiopia (NBPE) to promote the use of domestic biogas and to develop and disseminate commercially viable biogas in the country. The plan is to be undertaken by the Ethiopian Rural Energy Development and Promotion Centre of the Ministry of Water and Energy in the off-grid rural areas through the upscaling of the Programme.

A feasibility study was commissioned by SNV to assess the features and functions required for the establishment of NBPE, as well as to assess the future prospects of domestic biogas in the country. An extensive stakeholders' consultation process had been conducted with participation from representatives from the government, NGOs and the private sector, including members of the financial community, at both the regional and national levels. The feasibility study led to a formal partnership between the EREDPC and SNV/Ethiopia-National Biogas Programme. In 2007, a joint EREDPC/SNV team was established to develop a programme implementation document. Following the feasibility study and the subsequent drawing up of the programme implementation document, the Government of Ethiopia, with financial and technical support from SNV Ethiopia, launched NBPE, with the goal to improve the health, livelihoods and quality of life of rural households by exploiting the market

and non-market benefits of domestic biogas through such actions as replacing biomass for cooking and lighting and using high-value organic fertilizer from the bio-slurry. The programme comprises eight major components: promotion and marketing; training; quality management; research and development; monitoring and evaluation; institutional support; extension; and gender mainstreaming. NBPE was envisaged to begin with a five-year pilot implementation phase starting in 2008 and ending in 2012 to construct 14,000 biogas plants in four selected regions for the development of a commercially viable domestic biogas sector in the country (SNV, 2007). The lessons learned from this phase would then be used to design strategies for upscaling the construction of biogas plants to cover more areas.

(i) Objectives, design and implementation

The aim of the first-year pilot implementation phase of the programme is:

- To attract and strengthen institutions and organizations for the development of a viable national biogas sector.
- To ensure the continued operation of the biogas plants installed under the National Biogas Programme and maximize the benefits of the biogas plants to be installed.

The target is to construct 14,000 biogas plants of 4, 6, 8, 10 m³ in 18 selected districts (woredas) in four regional states; Tigray, Amhara, Oromiya and SNNP, over a period of five years. The rationale behind starting the first five-year pilot implementation phase of the programme in the four regional states is based on several factors:

- High human (> 70 %) and livestock population (~ 70 %).
- Severe deforestation and loss of natural vegetative cover resulting in serious land degra-

dation and a huge rural household energy imbalance.

- Relatively well-educated population and technology-adoption experience.
- Availability of relatively well-documented information.
- High level of woody biomass consumption.

The programme was designed to be implemented by multiple stakeholders. At the national level, the designated stakeholders were EREDPC, the defunct Ministry of Mines and Energy, and the Ministry of Water, Irrigation and Energy. At the regional level, energy departments were the lead institutions. The National Biogas Programme Coordination Office (NBPCO) and the Regional Biogas Programme Coordination Offices (RBPCO) were established to ensure the operational management of the programme.

Another responsibility of EREDPC is to monitor and evaluate the overall programme and approve annual plans and reports. NBPCO is tasked with coordinating and monitoring the day-to-day activities while SNV-Ethiopia supports the programme through advisory services, resource mobilization and knowledge brokering. Engagement with the private sector, such as biogas companies, cooperatives, and biogas appliance and component manufacturers was also planned, while NGOs would be recruited for house-to-house promotion of the technology, construction of the biogas plants, after-sale service provision and provision of microfinance to purchase the technology at a low interest rate on a long-term credit basis.

The total budget requirement for the implementation of the pilot phase of the NBP over a period of five years was estimated at 16.7 million euros, (208 million Br, \$22.8 million), with a 10 per cent share coming from the national Government (SNV, 2008).

(ii) Expected and realized outcomes and impacts

As stated in the objectives, the anticipated output is to distribute 14,000 biogas plants in four regions, and provide direct benefits to at least 14,000 households from domestic biogas through reduced use of traditional fuel sources, access to clean energy, reduced workload and health improvement. Improved soil fertility will be realized through the use of quality biofertilizer, thus resulting in improved agricultural output.

However, from situation analyses of the National Biogas-NAMA (CDKN, 2013), 5,000 out of the 14,000 biogas plants were to be built by the end of 2012. This achievement was in close agreement with the report of Nadew Tadele (2014)² who reported that the total biogas digester reached to 5011 at the end of 2012. The remaining 9,000 biogas plants were slated to be built during the latter part of programme implementation. From this figure, about 2013 biogas digester were built in 2013, and by the end of 2013 the total biogas production during 6 years period (2008-2013) amounted to 7024 (Nadew Tadele, 2014). Therefore, observations on the social, environmental and financial and economic benefits were made from the first five years of programme implementation with the achievement of 5000 biogas plant production (Table 6).

Based on the experiences from countries that implemented national biogas programmes, and from observations on rural household energy demand, SNV (2007) and SNV (2008) noted that a 6 m³ biogas plant would fulfil the rural demand for cooking energy and lighting with sufficient dung to feed the digester. Therefore, assuming the average size of the majority of the distributed biogas plants is 6 m³, the financial and environmental outcomes are estimated on the basis of 6 m³ biogas plants.

² Nadew Tadele 2014. National Biogas Programme Ethiopia-scaling up of domestic biogas in Ethiopia; January 23-24/ 2014, Rome.

Economic impacts

As shown in table 6, the first phase pilot project with a total of 5,000 biogas plants used 246,375 tons of cow dung to produce 9,362,250 kL biogas, which generated an estimated 6,227,932 MJ or 1,729,981 kWh of total available energy over a five-year period. Assuming that the selling price of electricity is 0.6 ETB/kWh, and is more stable compared to prices of other energy sources, the pilot project could have generated total revenue of (Br1,729,98 x 0.6), which translates to Br1,037, 989 Br (\$53,000) during the its five-year implementation phase.

According to SNV (2008), the estimated average investment cost for a 6 m³ biogas plant after taking out its own financial contribution and contribution to construction costs is ETB 4.3 million (\$220,000) (SNV, 2008), hence the total investment cost for the 5,000 biogas plants is ETB 21,550,000 (4,310 x 5). The 5,000 biogas plants generate 4,884,652 MJ/ year or 1,356,848 kWh/yr and provide annual revenue of 814,109 Br (\$41,000). Based on this, the total investment cost could be covered in less than three years. Meanwhile, if household expenditures on traditional woody biomass energy and commercial fertilizer were valued in, then the time required for covering the investment cost could be much shorter. In addition to savings of household fuel expenditures, the annual contribution of the project to household income generation would be as high as 163 Br (\$8.25)/household.

Funding for project could also come from carbon trading. The project has already offset emissions of 3,185,629 ton CO₂e from the use of traditional cow dung fuel, which is worth about \$9.6 million (Br188 million). It also potentially offset emissions of 3.7-18 tons CO₂ by replacing other energy sources, such as kerosene, LPG, charcoal and firewood. This suggests that biogas technology dissemination in rural Ethiopia could be an attractive business venture in rural areas if a sound product design document (PDD) is developed and reliable MRV systems are put in place.

The other income-generating activity from biogas plants is derived from substituting commercial fertilizer with bio-slurry. Given that the average fresh dung feeding for 6 m³ biogas plant is 45 kg/day (ref SNV, 2007 and SNV, 2008, table 6), and the total solid and volatile solid content is 0.2 and 0.15, respectively (Gaddisa, 2011), the total yield of organic matter (bio-slurry) produced from 5,000 biogas digesters over a period of five years is estimated to be 12.3 tons. Bio-slurry contains 1.6 per cent N and 1.55 per cent P amounting to a total NP-fertilizer of 2.15 per cent. The five-year total bio-slurry production of 12,318,750 kg would yield NP-fertilizer of 264,853 kg. In Ethiopia, regardless of soil types, the recommended application of NP-fertilizer is 200 kg/ha, i.e., with 100 kg UREA and 100 kg namaDAP. Given that the content of N in UREA and DAP is 47 per cent and 18 per cent, respectively, and that of P in DAP is 46 per cent, the amount to be applied to a hectare of land would be 65 kg N and 46 kg P, totaling to NP-fertilizer of 111 Kg/ha.

The bio-slurry production of 12,318,750 kg would substitute commercial fertilizer by 477,213 kg both for UREA and DAP. Assuming that the current buying price of DAP and UREA is 10 Br (\$.50)/kg, the project could have saved the farmers BR4,772,130 (\$243,000) for purchasing inorganic fertilizer to be applied to 2,386 ha of farmland, resulting in household saving of BR 950 (\$48) through fertilizer substitution. The use of bio-slurry could also improve the soil conditions and maintain sustainable soil fertility by increasing the moisture retention capacity and level of other soil nutrient elements that cannot be substituted by commercial fertilizer.

Table 6 shows the estimation of biogas and bio-slurry, available energy and CO₂e emissions from 5,000 biogas plants of 6 m³ during the 2008-2012 implementation period. Estimation is made on the basis of cooking efficiency of 55 per cent, calorific value of 22.1 MJ/kg, 1,000 biogas plants installation per year, functioning 365 days/year, daily gas production ranges 1,020-2,400 L/6 m³

Table 6: Project estimates of biogas, bio-slurry, energy and emissions: 2008-2012

	Project implementation period (years of biogas plant installation)					
	2008	2009	2010	2011	2012	Total
Biogas installed (Nr)	1 000	2 000	3 000	4 000	5 000	5 000
Biogas production (kL)	624 150	1 248 300	1 872 450	2 496 600	3 120 750	9 362 250
Available energy (MJ)	40 705	81 411	244 233	976 930	4 884 652	6 227 932
Bio-slurry production (kg) ³	821 250	1 642 500	2 463 750	3 285 000	4 106 250	12 318 750
Fresh cow dung feed (ton)	16 425	32 850	49 275	65 700	82 125	246 375
Cow dung CO ₂	5420.25	10 840.5	16 260.75	21 681	27 101.25	81 303.75
Cow dung methane	9 855	19 710	29 565	39 420	49 275	147 825
Cow dung methane CO ₂ e	206 955	413 910	620 865	827 820	1 034 775	3 104 325
Cow dung emission CO ₂ e (ton)	212 375	424 751	637 126	849 501	1 061 876	3 185 628.75

plant (1710 L daily average); stove hour 400 L/hour; daily fresh dung feeding 30-60 kg/6 m³ plant (average 45 kg); total solid (TS) content 0.2, volatile solid (VS) content 0.15.

Social impacts

The biogas plants generate sufficient energy for household consumption and, in some cases, this is much more than the energy demand of the household. The excess energy generated could be used to cover the energy demand of the nearby community and institutions. This may include schools, health centres, vocational schools and other public and government institutions located in proximity to the project. By supplying energy at affordable prices, biogas plants could contribute to reducing health problems associated with smoke from fuel and cow dung burning, thereby reducing family health expenditures. At the same time, the use of biogas reduces the time women and children spend on collecting fuelwood from long distances. This would provide women sufficient time to take care of their children, prevent the interruption of girls' schooling and mitigate social related-problems, such as rape. The National Biogas Programme includes an implementation package that includes training on biogas maintenance, installation and credit association. This will provide more jobs for

technical vocational training (TVT) graduates and construction cooperatives and small and medium enterprises.

Environmental impacts

The expected environmental benefits are derived from the potential of biogas plants to mitigate the use of traditional fuel sources (wood, charcoal and cow dung cakes) for household energy needs, thus reducing greenhouse gas emissions from deforestation and forest degradation. Another benefit is that it could mobilize additional revenue from carbon trading. As shown in table 7, the project, over the first five-year implementation phase, has produced a total of 9,362,250 kL biogas and generated total available energy of 6,227,932 MJ from feeding fresh cow dung of 246,375 tons. If this energy had been produced from fuel using traditional open stoves, 3,185,629 tons CO₂e would have been made.

In contrast, the actual emission from biogas has been estimated at 3,932 tons CO₂e, which is less than 1 per cent (0.1%) of the emissions from directly burning cow dung. Additionally, given that fuelwood consumption in Ethiopia is about 50 kg per month (18,250 kg per year) for a family of 5-6 members (Gadissa, 2011), then 5,000 households would demand 91,250 tons of fuelwood per year.

³ Annual bio-slurry production for 6 m³ = (45 kg dung x 365 days x 0.2) – (45 kg dung x 365 x 0.15)

Table 7: Comparison of energy content and emissions from various energy sources

Energy	Available energy	Fuel quantity	Content	Total CO ₂ e (ton)
Biogas	6,227,932 MJ (1729981 kWh)	9,362,250 kL (11,234,700 kg ⁴)	0.35	3,932.2 ⁵
	Heating value	Tons		
Wood	17 MJ/kg	35.9	0.5	65.7
Charcoal	29.3 MJ/kg	20.8	0.7	53.49
Kerosene ⁶	43.1 MJ/kg	14.2	0.26	13.5
LPG gas	26.6 MJ/kg	13.5	0.82	40.5
Electricity	3.6 MJ/kWh	1,729,981		

The households involved in the project have, therefore, reduced emissions by as much as 166,988 tons CO₂e from deforestation and forest degradation. Furthermore, by replacing biogas for wood and charcoal, the project has saved standing forest stocks of 35.9 tons and 20.8 tons from being harvested for fuelwood and charcoal, respectively. This is expected to offset emission of 65.7 tons CO₂e from direct wood burning or 53.4 tons CO₂e from charcoal burning. Additionally, replacing the fossil fuel energy sources, such as kerosene and LPG, with biogas has resulted in a modest emission reduction of 13.5 and 40.5 tons CO₂e, respectively.

(iii) Cross-cutting issues

Improved household living conditions, better soil and reduced emissions from deforestation and livestock resulting from the first phase of project implementation have translated into improved health and increased access to biogas technology and knowledge transfer. The installation of biogas plants is supported by training packages on biogas technology. The construction of the plants has resulted in major income-generating activities that include biogas installation, operation and maintenance. Knowledge-transfer packages have particularly targeted Technical and Vocational Education and Training (TVET)

graduates, cooperatives and SMEs. Long-term credit services have enhanced access to clean and affordable energy to many households. The increased income enables beneficiaries to purchase productive assets, such as livestock, to further diversify their sources of income.

The National Biogas Programme project enhances climate change mitigation and adaptation efforts by reducing greenhouse gas emissions from deforestation and forest and soil degradation. Settled farming communities in large pastureland areas are encouraged to install biogas plants individually or collectively in order to benefit from the high potential emission reduction of biogas from various carbon trading mechanisms, such as REDD and CDM. In this regard, there are ongoing projects on PDD for biogas nationally appropriate mitigation action (NAMA). The move towards scaling up biogas technology through the construction of 100,000 biogas plants throughout the country and biogas NAMA-PDD will explore REDD+, CDM and voluntary carbon markets and will promote the self-financing of national biogas programme projects. The income derived from carbon trading can be used to fund maintenance and operational activities. In this respect, biogas-NAMA and biogas-CDM payment modalities and MRV systems should be developed, tested and verified in the selected areas and woredas where large numbers of biogas plants have been built.

4 Based on biogas bulk density 1.2 kg/m³; heat value 22.1MJ/m³; 18.4 MJ/kg

5 CO₂ emission from biogas burning is estimated based on CO₂ content of 30-40% (average 35%) in biogas (source: Gaddisa, 2011).

6 CO₂ emission of kerosene is calculated based on specific CO₂ emission value of 2.6 (kgCO₂/kWh)

(iv) Sustainability and replicability

The NBP implementation was realized by successfully installing 5,000 biogas plants over a five-year period. The economic, social and environmental benefits were substantially higher than envisaged, particularly in regards to rural household incomes, improvement of soil conditions, reduction of deforestation and mitigation of greenhouse gas emissions. The regions and woredas where the 5,000 biogas plants have been installed were selected very carefully using such criteria as cattle-holding size per head, human and livestock population and availability of water and feeds.

Substantial lessons have been learned, particularly with regard to tackling constraints. Based on the realized economic, social and environmental outcomes of the pilot biogas plants, the Government is planning to install an additional 100,000 biogas plants as part of the GTP and the CRGE implementation strategy. The successful implementation of the pilot phase of the programme and the lessons learned will facilitate the scaling out of 100,000 biogas plants throughout the country

(v) Lessons learned

Some of the lessons learned are discussed below:

- The implementation of the first phase of the biogas programme as a pilot project with the effective engagement of government sector ministries at federal, regional and woreda levels has been very useful for the sustainable supply and dissemination of biogas technologies, as well as for the programme's sustainability.
- Integrating a complete set of biogas technology dissemination packages ensured the transfer of knowledge, skills and technology for outscaling.
- The substantial reduction of greenhouse gas emissions reduction generates significant interest on the part of the government and development partners to register the upcoming biogas projects as clean energy projects to attract climate finance.
- The involvement of women, girls and boys as equal partners in project implementation has helped in promoting social inclusion, youth employment and gender equality.

Case study 5: Hydropower development projects

Ethiopia has vast hydropower potential (about 15,000-30,000 MW). Hydropower development in the country dates back to 1932 with the installation of a station at Aba Samuel. Since then, a total of 15 power stations have been installed, and about 5,293 MW, which is less than 2 per cent of the maximum potential,(table 8). Hydropower is the main source of power generation, accounting for 95 per cent of total generation capacity on the national grid (Hailu, 1998; EEPSCO, 2013). Some 300 hydropower plant sites in the major eight river basins with a total technical power potential of 159,300 Gwh/year have been identified. Out of these potential sites, 102 are large scale (more than 60 MW) and the rest are small (less than 40 MW) and medium-scale (40-60 MW).

The embassy of Japan in Ethiopia has studied the energy sector in Ethiopia and reported that in 2008, a total of 758 MW energy supply was generated from hydropower (670 MW), geothermal (7.3 MW) and from Diesel (80 MW). According to the report, EPPCO plans to increase the generation capacity to 3000 MW by 2012 when the Gilbel Gibe III Power Plant is completed. Furthermore, EEPSCO plans to expand the large hydropower expansion project to generate 11532 MW in 2016. Currently, substantial progress has been made in exploiting the country's vast hydropower potential in order to achieve a sustainable energy supply.

Table 8: Hydropower plants and installed capacity

No.	Hydroelectric power station	Type	Capacity (MW)	Year completed	Name of reservoir	River
1.	Aba Smuel	reservoir	6	1932		
2.	Tis Abay I	reservoir	12	1953	Lake Tana	Abay River
3.	Koka	reservoir	43	1960	Lake Gelila	Awash River
4.	Awash II	reservoir	32	1966	Lake Koka	Awash River
5.	Awash III	reservoir	32	1971	Lake Koka	Awash River
6.	Fincha	reservoir	134	1973		
7.	Melka Wakena	reservoir	150	1989		
8.	Sor	reservoir	5	1990		
9.	Tis Abay II	reservoir	73	2001	Lake Tana	Abay River
10.	Gilgel Gibe I	reservoir	184	2004	Gilgel Gibe Reservoir	Omo River
11.	Tekeze	reservoir	300	2009	Tekeze Reservoir	Tekeze River
12.	Gilgel Gibe II	run of river	420	2009	Gilgel Gibe Reservoir	Omo River
13.	Beles	reservoir	460	2010		Lake Tana/ Beles River
14.	Gilgel Gibe III	reservoir	1870	2013		Omo River
15.	Fincha Amerti Neshe	reservoir	100	2013		
16.	Gilgel Gibe IV	reservoir	1472	2014		Omo River
	Total till 2013	reservoir	5293			
17.	Grand Ethiopian Renaissance Dam	reservoir	6000	2018		Blue Nile River
18.	Halele Worabesa	reservoir	440	2015		Omo River
19.	Chemoga Yeda	reservoir	278	2015		
20.	Total Capacity (MW)	reservoir	12011			

Source: Solomon Seyoum Hailu (1998); Abebe Tesfaye (2000).

By 2018, the total available hydropower supply is expected to be greater than 12,011 MW – more than 40 per cent of the maximum potential), indicating that more than 92 per cent of the planned hydropower development would be achieved by 2015. When the Grand Renaissance Dam is completed, the total energy supply is expected to exceed 18000 MW. Detailed accounts on hydropower project development in Ethiopia are described by Hailu (1998) and the embassy of Japan in Ethiopia (2008).

(i) Objectives, design and implementation

Hydropower expansion projects were initiated by the Government as part of GTP and the rural electrification programme through grid-connected electricity supply. They are now aligned with fast-track projects of the CRGE strategy towards achieving the economic growth targets of GTP, with a zero increase in greenhouse gas emissions.

The objective of the projects is to switch off the current diesel power plants and off-grid generators in 2012-2014 and to generate power exclusively from renewable sources for domestic use and export to neighbouring countries (CRGE, 2011). Exporting clean energy to other countries could capture a share of monetization of their reduced emissions for mobilizing international grants and promoting regional economic development through the provision of more renewable hydropower energy at a reasonable cost; for Ethiopia, it would contribute positively to its trade balance. The project also promotes energy security for the sustainable development of other economic sectors, such as industry and transport.

The project implementation plan consists of:

- Conducting major electric power planning and market survey studies. Forecasts for power and energy demand and supply have been made for up to 2040. A 1993 forecast predicted the possibility of very acute power and energy shortages starting from 1995.
- Conducting detailed reconnaissance studies of hydropower potential sites and environmental impact studies within strategic river basins (Tekeze, Gojeb and Abbay).
- Developing medium-scale hydropower plants (40-60 MW capacities) in strategic river basins.
- Mobilizing and securing finance for establishing large-scale hydropower development schemes that require large investments and longer construction periods.
- Preparation of detailed engineering designs of hydropower projects and expanding transmission grids.

The Ministry of Water Resources, Energy and Irrigation is the lead organization for the projects. It is responsible for signing contractual agreements with international consultants to undertake pre-feasibility and feasibility studies of both medium- and large-scale hydropower projects. The ministry consists of directorates and agencies that have specific roles and responsibilities. The Water Works Design and Supervision Enterprise prepares a detailed design of the projects. EEPSCO, which is, within the Ministry of Water, Energy and Irrigation, is the responsible agency for electric power in Ethiopia. In this regard, it handles the investigation, development and subsequent construction of power-generation schemes. It is also responsible for the transmission and distribution of electrical energy. Previously, small power-generation facilities were installed by the former Rural Infrastructure Development Department of the Ministry of Agriculture and Rural Development.

Based on a projection of the country's energy requirements for the period 1990-2040, EEPSCO has concluded that power generation needed to be increased by four times by the year 2000 and needs to be increased by more than 14 times by 2020 and about 25 times by 2040. In 1998, EEPSCO distributed electrical power to 365 towns, which represented 92 per cent of the total energy produced. It plans to expand large hydropower development from the present level of 1,500 MW on the national grid to 13,000 MW by 2030 (EEPSCO, 2006).

The Grand Ethiopian Renaissance Dam (GERD) is part of this expansion programme. This \$4.2-billion hydroelectric power project is part of the country's grand plan to use it to export power to its neighbours. Upon completion, it will have the capacity to generate 6,000 MW. The project construction started in 2011 and is expected to be completed by 2015. Funding for it is through self-financing and from public investment; public participation has been mobilized in the funding process the purchase of government bonds.

Figure 6: Examples of completed and under construction hydropower projects in Ethiopia: A. Design of GERD; B. GERD under construction; C. Tekeze and D. Beles Dams completed



The construction-implementation and pre-feasibility studies of the projects were financed through grants and loans and entailed the engagement of consulting firms. For example, for the feasibility study of Baro and the pre-feasibility study of the Karadobi multipurpose hydropower projects, the Government of Ethiopia received a grant of 40 million Norwegian kroner (NOK) (Br128 million, \$6.5 million), from the Government of Norway, and the pre-feasibility studies were conducted by Norplan in association with Norconsult in 1999.

(ii) Expected and realized outcomes and impacts

The hydropower projects are aimed at exploiting the immense hydropower resources and replacing diesel generators in order to deal with social, economic and environmental impacts associated with the energy sector. The ultimate goal is to boost the country's trade and investment opportunities in order to realize the goals of GTP and contribute to the country's efforts in mitigating greenhouse gas emissions. The anticipated impacts include the use of abundant water resources to generate hydroelectric power for rural and urban settings, increased foreign exchange reserves stemming from the expected export of the power to neighbouring countries, and reduced reliance on imported fossil fuels and a reduction in greenhouse gas emissions, which could enhance access to climate finance.

The completion of hydropower projects by 2018 is anticipated to make a significant contribution to emissions mitigation to the tune of 50 Mt CO₂e by 2030. This is expected to enhance the efficiency of other economic sectors, such as agriculture, industry, rural and urban infrastructure, and to reduce emissions contributed by these sectors. Thus, small-, medium-, and large-scale hydropower projects provide ample opportunities for greening the Ethiopian economy.

Economic impacts

Despite substantial hydro-power resources, Ethiopia has one of the lowest levels of per capita electricity consumption in the world. Also, although the electricity price tariff is cheaper compared to other countries, it is hardly affordable by low-income communities. Following the implementation of a series of economic development policies, such as PASDEP, the country posted economic growth that exceeded 10 per cent per year. Further gains in economic growth, however, are hampered by electricity rationing due to a power supply shortage. Hence, adequate supplies of electrical energy at affordable prices are essential for sustaining the current level of economic growth and ultimately lifting a large proportion of the population from severe poverty. Additionally, the hydropower schemes are integrated with irrigation and water supply projects to maximize the benefits from the country's abundant water resources. Examples of this are the Baro and Karadobi hydropower projects under the Nile Basin Initiative, and the Eastern Nile Subsidiary Action Programme, The basin countries see the development of regional electricity markets as an important component of their strategy to promote economic development and cooperation in the region. These projects are intended to generate income and make improvements in several areas, thus, creating win-win situations for the countries involved (Ethiopia, Sudan and Egypt). In addition to the sale and export of electricity, the Baro and Karadobi projects assist downstream riparian countries in such areas as irrigation and water conservation.

Such multipurpose regional projects are expected to promote regional economic development through the provision of hydropower energy at a reasonable cost.

Many hydropower development plants are incorporated in the system to utilize the flowing water to irrigate sugarcane fields. The Ethiopian Sugar Development Agency (ESDA) was established in 1998 as an institute to be responsible for large-scale sugarcane development. One such multipurpose project is centred on the Kesem irrigated sugarcane fields in the Kesem and Bolhamo areas. The project enables the production of 10 to 15 MW of power with only the cost of electromechanical equipment as an additional investment.

Other hydro dam projects associated with sugarcane production and the establishment of sugar factories are Tendaho, Wonji-shewa, Metehara at Awash and Fincha at the Fincha hydro dam plants. These projects are expected to produce annual yields of 542,559 tons of molasses, 1,520,717 tons of sugar, and 24,700 m³ of ethanol. ESDA (2007) indicated that 130 million litres of ethanol could be produced from the molasses in 2012/13 (ESDA, 2007) when all projects were slated to have been completed and were fully operational. The Fincha sugar factory generates electric power from bagasse, with 46.4 per cent of its ethanol production sold domestically and the rest exported. In addition, small-scale farmers organized as out-growers to produce feedstock on 112 ha of land are able to supply 12 metric tons of cane for the Wonji-Shao factory. This process has led to an increase in household incomes of the farming communities. All these integrated hydropower plant projects provide avenues for greening the Ethiopian economy inclusively.

Social impacts

As shown in table 8, an additional four large-scale hydropower plants with a total capacity of 8,190 MW are expected to be completed by 2018, boosting the country's hydro potential to 11,881

MW in 2018. The mega-dam, GERD, scheduled for completion by 2018 is expected to generate 6,000 MW of energy. This secures the energy supply for shifting the transport system from road to rail and the conversion of all public transport vehicles to electric vehicles, and will ultimately result in a reduction in traffic congestion, pollution and accidents, as well as more efficient and affordable public transport services.

The development of small-scale hydropower schemes contributes to rural development and attracts private investment. The projects, which are part of the rural electrification programme, have fostered the establishment of government offices and associated services in remote areas. They have also contributed to improving the quality of educational, health and other services and enabled individual rural households to have access to amenities that were earlier restricted to urban areas. The source of energy would also encourage the establishment of agro-processing and cottage industries, which would contribute to employment opportunities in rural areas and foster inclusive green growth in Ethiopia.

Due to cost effectiveness, small hydropower plants with a capacity of less than 40 MW are on the increase and provide power to off-grid rural towns, replacing many of the diesel-engine-operated grain milling with electric grain milling. Under diesel-operated systems, the price of grain milling is lower and the time spent by women and girls (who also take care of babies at grain milling plants) is less. This ultimately plays a role in realizing social equity and improving mother and child care. When the projects are fully operational by 2014-2018, they will provide employment for more than 100,000 workers (ESDA, 2007), and will benefit groups that tend to be disproportionately unemployed, such as young people, women and girls and underemployed. The mega-dam, scheduled for completion by 2018, is likely to spur economic growth further and is expected to create 12,000 jobs.

Environmental impacts

The environmental impacts of the hydropower projects are directly related to their abatement potentials, as their output will replace fossil fuels in the industry and transport sectors. These projects will enable the conversion of the vehicles in public transport that use fossil fuels to electricity-driven ones, diesel generator power houses to electric power and diesel-engine grain milling to electric milling, thus considerably reducing emissions from the largest source of transport emissions both in rural and urban areas.

The completion of the Ethiopian hydropower projects by 2018 is anticipated to increase the available hydropower energy to 1,201 MW (see table 8). This would result in replacing a substantial amount of fossil fuels and make a large contribution to emissions reduction. Hydropower dams are also integrated with irrigation schemes. This, in turn, reduces the negative impact of droughts on GDP and livelihoods, and promotes enhanced climate-resilient building. Furthermore, the reservoirs provide a high degree of regulation of inflows, flood mitigation and reduce sediment deposition, which is more advantageous for the downstream communities and countries, such as Egypt and Sudan. This also promotes regional development partnership.

(iii) Cross-cutting issues

As discussed above, the development of hydropower dams and integrating them with irrigation systems would curtail the growth of greenhouse gas emission sources and impacts of drought and flood on the agriculture sector, thus promoting climate change mitigation and adaptation. The expansion of small-, medium- and large-scale hydropower dams would improve energy access to all citizens at affordable prices. Incorporating the development of hydropower plants in the system to utilize the flowing water for irrigation has facilitated the production of power for off-grid towns. It has also helped reduced

dependence on seasonal rainfall of the pastoral and agro-pastoral communities.

When all the projects are completed, they are expected to offer high potential for multipurpose benefits through integrated planning, including new technology for flood alleviation and the regulation of flows for irrigation through deep-tunnel waterway construction. New jobs are now becoming available for university and TVT graduates. University professors and researchers are being hired as local consultants for all stages of project development and implementation. All these facilitate the provision of knowledge and technology.

(iv) Sustainability and replicability

The hydropower projects (small scale, medium scale and large scale) are expected to support the development of key sectors, industry, agriculture, education, health and transport, through the provision of affordable energy from electricity and water supply. This would support the involvement of the private sector in the emerging businesses and increase investments in the different sectors, thus ensuring economic sustainability. Additionally, by using the services of highly experienced Ethiopian dam engineers (dating back to 1932) who have extensive heir knowledge on the geological set-up of the hydro sites, the costs of the feasibility studies and maintenance has been less capital intensive, particularly in the case of small-scale dams, thus enhancing sustainability.

The small- and medium-scale hydro dams provide off-grid connections and ensure power supply to rural towns and regional capital cities. These provide the opportunity for expanding the energy supply to all sectors across the country. Based on the knowledge and skills of the Ethiopian dam engineers, who have been working as independent consultants or with foreign consulting firms, the Government of Ethiopia

is now working on constructing GERD using national experts and public finance. GERD is a good example of the replicability of the projects.

(v) Lessons learned

Since the establishment of the Aba Samuel hydro dam in 1932, Ethiopia has constructed many small-, medium-, and large-scale dams for energy and irrigation schemes. The important lessons learned during these years of power and irrigation dam constructions include:

- Integrating the development of hydropower plants in the system to utilize the flowing water for irrigation purposes is cost effective and reduces the dependency of the community on rain-fed agriculture.
- In addition to the sale and export of electricity, the integrated development of the projects has helped mitigate flooding and siltation that affect downstream riparian areas.
- Given that a number of highly populated villages are situated along the river valley where hydro dams are built, carefully planned resettlement programmes must be implemented.
- Small-scale hydropower plants are being implemented by a number of private firms in a cost-effective manner. They are quite effective in contributing to rural development rather than increasing the nation's energy-generating capacity. Also, the large-scale plants are supposed to be more cost effective and efficient, hence able to supply electricity at lower price/unit.

4. Transport Sector

In this sector, there are two sets of projects that are directed at developing the sector in a way that it contributes to the sustainable development of the country. They are core investment projects that are aligned with the goals of GTP and CRGE. These projects are expected to foster economic development, while keeping greenhouse gas emissions at the present level, a feature that is expected to attract development partners to support the implementation of CRGE.

Case study 6: National railway and bus rapid transit projects

(i) Objectives, design and implementation

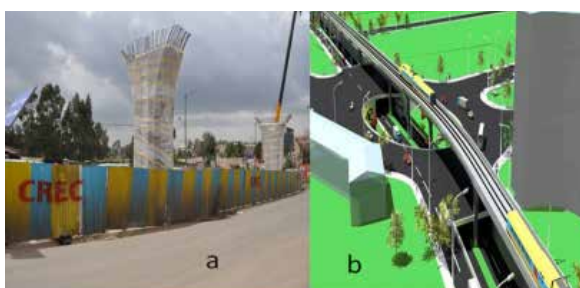
The projects were initiated by the Government of Ethiopia as part of the CRGE strategy towards achieving the economic growth targets of GTP, with a zero increase in greenhouse gas emissions. The objective of the projects is to shift freight transport from road to an electric rail network to eliminate emissions from the largest source of greenhouse gas emissions in the transport sector and to promote economic efficiency. The project implementation plan comprises:

- Construction of an electric rail network that is powered by renewable energy and will serve as a substitute for road freight transport on the major import-export corridor.
- Improving urban transport in Addis Ababa by introducing urban electric rail and enabling fast and efficient bus transit.
- Introduction of stricter fuel-efficiency standards for passenger and cargo transportation and promote purchase of hybrid and electric vehicles to counter the low efficiency of the existing vehicle fleet.

The national railway is among the seven main routes in the country. The construction of the route that connects Ethiopia (Addis Ababa) with Djibouti has commenced. The route is the major import-export corridor of the country.

With regard to bus rapid transport (BRT), one of the recommendations in an urban development study conducted in 2005 was for the development of a light rail transit (LRT) system for the North-South corridor and a BRT system for the East-West corridor in Addis Ababa. The two transit line systems are now under construction (see figure 7).

Figure 7: Construction (a) and design (b) of the Addis Ababa Light Rail Transit



The objective of the \$15.6-billion National Railway Project (NRP), is to connect economic corridors of the country with each other and with neighbouring countries. The total railway network covers 4,787.6 km, out of which 2,395 km is planned to be constructed in the first phase. The LRT and BRT transit lines are intended to account for 72 per cent of public transport activity in the capital. When the construction is completed and the railway lines are fully functional, the Addis Ababa Light Rail Transit alone will have a total of 41 railroad cars, each with a capacity to carry 286 passengers; this will provide transportation services to 15,000 people per hour in one direction and 60,000 in all four directions.

The design of the projects entails engaging relevant stakeholders mainly through consultation on the feasibility study and on the Environmental and Social Impact Assessment. The sector ministries and agencies have specific roles and responsibilities: The Ethiopian Railway

Corporation is responsible for designing and implementing the projects; and the Ministry of Transport, the regulatory body for the transport sector, is working in partnership with regional governments, community service organizations, international institutions, the private sector and academic institutions. The China Rail Engineering Corporation is building the Addis Ababa Light Rail and the Addis Ababa-Djibouti railway. A Turkish firm, Yapi Merkezi, has been awarded a \$1.7 billion contract for the construction of the railway from Awash to Woldiya, covering a total length of 389 km (243 miles).

Government institutions in the partnership include the Environmental Protection Agency as the government agency responsible for coordinating CRGE, and the Ministry of Finance and Economic Development, which is in charge of the national development plan and budget. The Ministry of Transport and the Environmental Protection Agency are responsible for monitoring and evaluation. Since the projects are designed to meet an important objective of GTP and CRGE, such as fostering the transition to a green economy in Ethiopia, the overall responsibility to oversee the implementation of CRGE lies with Environmental Council of Ethiopia, which is chaired by the Prime Minister (CRGE, 2010).

(ii) Expected and realized outcomes and impacts

The NRP, LRT and BRT projects are aimed at dealing with the social, economic and environmental impacts associated with the transport, energy and industry sectors, boost the country's trade and investment opportunities and contribute to the country's effort in mitigating greenhouse gas emissions. The anticipated impacts include the abundant use of renewable energy sources, such as hydroelectric power, ethanol, biofuel, solar and wind, leading to the reduction of foreign currency expenditure on imported fossil fuels and a reduction of greenhouse gas emissions, which could enhance access to climate finance.

The NRP project will service the major import-export corridor of the country, connecting the capital with the seaport of Djibouti. The completion of this project is anticipated to lead to a shift of 50 per cent of cargo from freight vehicles. This is expected to enhance the economic efficiency of freight transport and reduce emissions from this form of transport. The LRT and BRT transit lines are expected to result in the replacement of about 200 city buses with electric buses and rails, while for BRT lines about 80 diesel buses are slated to be replaced. Thus, implementing these projects provides ample opportunities for greening the Ethiopian economy.

Economic impacts

The total shipment cost for export commodities would be significantly reduced as a result of the refurbishment of the railway connecting Addis Ababa to the seaport of Djibouti. The shift from using road to rail transport would reduce transport costs and increase foreign currency accumulation through improved trade balance and reduced import of fossil fuels by 2030. Lower transport costs would translate into savings of \$0.03 per ton-km in 2030. This, in addition to the lower energy cost that would result from the expansion of renewable energy sources for electric power generation, would enhance the efficiency of the industry sector and the quality of products, which, in turn, would make the industry sector more competitive by reducing production costs.

Social impacts

This shift to using rail transport as opposed to road transport along with the conversion of public transport vehicles to electric vehicles would result in less traffic congestion, pollution and accidents. Replacing diesel-powered public transport with electric rail and electric-powered vehicles is projected to lower transport costs and improve the efficiency and affordability of public transport services, thus facilitating sustainable access to public transport. This could reduce the traffic hazards that result in substantial loss of human lives and damage to property.

The projects would also reduce the negative impacts on human health caused by high concentrations of toxic gases. In rural towns, where obsolete vehicles provide public transport services and the road conditions are not conducive for modern and energy-efficient technologies, three-wheeler electric vehicles could be used for as a means of ready access to transport without raising greenhouse gas emissions. Furthermore, the projects would provide substantial job creation opportunities, income generation and social welfare, as well as help redistribute wealth. When the projects are fully operational, they will provide employment for more than 300,000 people, in particular young people, women and girls, all of whom are disproportionately unemployed and underemployed.

Environmental impacts

The environmental impacts of the projects are directly related to their abatement potential. Converting public transport fossil-fuel vehicles to electricity-driven vehicles and diesel generator power to electric power is expected to considerably reduce emissions from the largest source of transport emissions. Shifting freight from diesel-powered vehicles to electric-powered public transport freight vehicles could have abatement potential of as high as 13.3 Mt CO₂e. This is broken down as follows: 8.9 Mt from NRP; 3.1 MT from fuel-efficient standards for passenger and freight vehicles; 0.2 MT from LRT and BRT; 0.1 MT from hybrid electric vehicles; and 1.0 from mixing ethanol and biodiesel.

As a result of the expansion of LRT and BRT, 280 buses that are run on diesel are to be replaced by electric busses, an action that has an emission reduction potential of 33,500 ton CO₂e per year. Additionally, 282 other city buses and about 9,000 mini-bus taxis that provide public transport services in Addis Ababa, if converted to electric vehicles, would have a potential emission production of 33,500 and 117,000 ton CO₂e per year, respectively. About 2500 3-wheeler taxis are currently operating in larger cities in the

country outside Addis Ababa. Electric operated 3-wheeler vehicles are now being promoted in Dire Dawa. If these vehicles become popular, this would technically result in the conversion of gasoline-operated vehicles to electric ones. This transformation would have the potential to reduce the emission of about 3,000 tons of CO₂e per year.

(iii) Cross-cutting issues

As discussed above, the establishment of an electric transport system would curtail the growth of greenhouse gas emission sources, and, in turn, promote climate change mitigation. The introduction of an urban electric rail system would improve fuel efficiency standards and result in an influx of hybrid and electric vehicles. As electric system installation and deep tunnel construction, as well as its design, are quite new technology for Ethiopia, the country would benefit from the expanded knowledge base and from a new climate that promotes the use of innovative technology along with the development of an efficient public transport at affordable transport cost. In addition, it would encourage a new generation of foreign investment, lead to the creation of new jobs and encourage and provide a safer transport system, thereby contributing to the expansion of health and education services.

Transforming the public transport system from vehicles that use fossil fuels to electric-powered railways and bus transit would provide large abatement potential of greenhouse gas emission and result in substantial social, economic and environmental benefits. These interventions in the transport sector are priority areas for implementing GTP and CRGE, and could help Ethiopia attract more climate change funds.

(iv) Sustainability and replicability

The projects are expected to support the development of two key economic sectors, industry and transport, through the provision of affordable electricity. This would support emerging businesses and increase investment in the industry and transport sectors, thus ensuring economic sustainability. Additionally, the reduced cost of exports would funds available for financing the railway system between Addis Ababa and the seaport of Djibouti. Also, as maintenance of a railway system costs much less than that of an asphalt road, keeping the railway line connecting the two cities in good condition would be less capital intensive than maintaining heavy-track highway roads and thus would enhance sustainability. In rural towns and regional capital cities, the cross-country railway connection would increase the availability of public transport services at a reduced unit cost per customer. These factors justify the expansion of these projects to larger regional cities with high populations.

(v) Lessons learned

As the projects are in the initial implementation phase, it is too early to draw any lessons learned. The technology of these transport systems is new to Ethiopia. Thus, the participation of several Ethiopian engineers, designers and other workers in the project would help create skilled labour and enhance technology transfer. The important lessons learned at this stage relate to the importance of involving nationals in the construction of major infrastructure projects:

- Tunnels that are about 20 meters deep have been dug. The work involved in building the tunnels is helping to raise the skill-level of Ethiopian experts and labourers and expand their knowledge on soil/earth and civil works for constructing deep underground tunnels stretching several kilometres.

- The railway network consists of several rail routes connected with two-line rail tracks that are underground, as well as above ground. Ethiopian engineers and designers are involved in the construction and designing activities. The knowledge and skills gained will enable locals to design and construct multiple-line rail tracks extending several kilometres and stretching in all directions.
- The statue of His Holiness St. Abune Petros has been removed during the construction and temporarily placed at the National Museum. It will be put back in its original location once the construction is completed. This has been overseen by several institutions, including those involved in research and academia, conservation and cultural heritage and road works. The nationals involved in this delicate operation are acquiring skills in moving historically important monuments.
- The construction has caused major traffic congestion and disruption in certain areas, resulting in considerable losses to businesses along the construction routes. Some of the inconveniences and losses could have been minimized or avoided by geographically phasing the construction, particularly in Addis Ababa, where traffic congestion is the heaviest.

IV. Conclusions and recommendations

A. Conclusions

The Government of Ethiopia developed CRGE with the intention for it to serve as a road map for promoting inclusive green growth and fostering the country's transition to a green economy. Through the promotion of inclusive green growth, the Ethiopian economy is expected to become: sustainable and resilient to climate and environmental shocks; attain a competitive advantage in terms of using renewable energy in a sustainable manner; and become a source of jobs with high-productivity; while in the country, social equity and gender equality will be enhanced.

Ethiopia is one of the first African countries to embrace inclusive green economy in its development agenda. However, the Government's commitment will be critical in implementing the projects showcased in this study. This has already been demonstrated through the implementation of GTP and CRGE. The Government has also recognized the need to establish well-resourced and dedicated institutions with effective governing structures and capacity for implementation. In addition, the promotion of public-private partnership ventures and international partnerships in implementing CRGE has enabled the Government to meet the high initial investment costs and give it access to green investment funds. The Government has also shown its commitment by putting in place policies that promote technology development and transfer, which have already facilitated technology transfer from development partners, financial institutions and the private sector.

The challenges going forward are many, including financial sustainability and sustaining the momentum to the implementation, particularly through institutional stability. This is especially significant because the key sectors highlighted

in the case studies have been domiciled under different institutional set-ups. The water, energy, agriculture and forestry sectors are key sectors in the promotion of inclusive green growth and fostering the transition to a green economy. Notably, the performance and development of these sectors have been affected by institutional instability and frequent restructuring. For example, the energy sector was under the Ministry of Mining and Energy, then it was merged with the water sector to form the Ministry of Water and Energy. Likewise, the forestry sector has been repeatedly disbanded, amalgamated with or subsumed into other departments within the Ministry of Agriculture or re-established as a stand-alone institution. Frequent institutional restructuring, such as this, could affect professional commitment and result in high staff turnover, the disintegration of information databases, discontinuity of planned activities and inadequate awareness, knowledge and technical capacity.

Furthermore, ensuring financial sustainability of the projects will place a huge burden on the Government and peoples of Ethiopia. For instance, increasing electricity generation from renewable energy sources to secure domestic consumption through rural electrification and regional markets is capital- and technology- intensive, requiring an estimated budget allocation of more than \$150 billion. The correct valuation of the final products will be critical for financial sustainability as well as for the social inclusiveness of the resulting benefits.

B. Recommendations

In view of the above, the report recommends the following:

- (a) Acknowledging the importance of GTP and CRGE with regard to the development aspirations of Ethiopia as they provide the most coherent framework for attaining various goals, including inclusive green growth.
- (b) Harmonizing regional development plans with the national strategies embodied in GTP and CRGE. This action will be critical for the success of the inclusive green economy transformation agenda.
- (c) Taking stock in community/regional projects. They are instrumental in empowering communities and have the potential to foster inclusive green growth in a way that has wider social benefits if they are implemented through collaborative efforts between the government and development partners on one hand, and between the partners and stakeholders on the other. Projects that have technology development and transfer as a component of implementation are likely to have the greatest impact.
- (d) Carefully planning large-scale projects that are likely to affect a large number of people so that they cater to their various needs. Adequate consideration must be given to impacts, such as resettlements and displacements, as well as social welfare policies in order to balance infrastructure development with social progress.
- (e) Evaluating and continuously monitoring the governance of the various inclusive green growth projects under GTP and CRGE to ensure that the projected benefits are trickling down to the intended constituents of society.
- (f) Training and upgrading of skills, which is a critical aspect in innovation, technological development and transfer, as well as in upscaling projects. The involvement of women and young people from the onset of the project design and implementation could help in promoting social inclusion, transfer of knowledge and skills development.

V. Annex: List of experts interviewed

Name	Institution	Position
Dr. Alganesh Tesema	Institute of Biodiversity Conservation	Programme Coordinator
Mr. Sertse Sebu	Ministry of Agriculture Ministry	Climate-Resilient Green Economy Team Leader
Dr. Yitebitu Moges	Ministry of Environment and Forest	REDD+ Coordinator
Mr. Shimelis Sima	Environmental Protection Agency	CRGE Coordinator
Mr. Melaku Tadesse	Ministry of Agriculture	Sustainable Land Management Project Coordinator
Mrs. Yetmyet Berhanu	Ministry of Transport	Strategic Management Directorate, Director
Mr. Damtew Bekele	Tana Integrated Watershed Development Project; Ministry of Water Irrigation and Energy	M &E Specialist
Mr. Trefe Wolde Gebriel	Biosphere Reserve Kefa	Project Manager
Mr. Alemayehu Tafesse	Ministry of Water and Energy	Head of the CRGE Unit,
Mr. Tezera Chernet	International Network for Bamboo and Rattan (INBAR) Project Bambo	GIS Expert
Mr. Shewaye Deribe	Ethio Wetlands and Natural Resources Association (EWNRA)	Programme Director

VI. References

- Abebe Alebachew (2010). A situation analysis on investing on boys and girls: Past, present and future. Working paper 06.
- Alebachew, Adem (2009). Potential social and economical impacts of agro-fuels in Ethiopia and the need for social standards. In proceedings of international conference on the status of biofuel development and uses in Ethiopia, Faculty of Science, Addis Ababa University, 20-21 October.
- Andargachew, A. (2009). Draft proceedings from the PFM Working Group Meeting, 5-6 March, Jimma, Ethiopia.
- Anonymous (2007). Get the gangsters out of the food chain. *The Economist*, 7 June.
- Apollo Alliance and Green, Center for American progress and Center on Wisconsin Strategy (2008), Green-collar jobs in America's cities: Building pathways out of poverty and careers in the clean energy economy. Available from <http://americanprogress.org/issues/green/report/2008/03/13/4170/green-collar-jobs-in-americas-cities/>.
- Tenalem, Ayenew (2012). Current Status of and Threats to Selected Ethiopian Wetlands in 2010. In Eds. Sue Edwards, *Ethiopian Environment Review*. Forum for Environment, Addis Ababa, Ethiopia. P 49-70.
- Bekele M., and T. Bekele (2005). Participatory forest management in Ethiopia: Bonga and Chilmo. Final evaluation report. Addis Ababa.
- Denu, Berhanu, Abraja, Tekete, and van der Deijl, Hanah (2005). Characteristics and determinants of youth unemployment, underemployment and inadequate employment in Ethiopia. Employment Strategy Papers, Employment Policies Unit, Employment Strategy Department. Available from http://www.ilo.org/wcmsp5/groups/public/@ed_emp/@emp_elm/documents/publication/wcms_114148.pdf.
- Berry and others (2003). Ethiopian Strategic Investment Framework for Sustainable Land Management. Ministry of Agriculture and Rural Development. Addis Ababa.
- Breithenbach, F. (1961). Forests and woodlands of Ethiopia: A geobotanical contribution to the knowledge of the principal plant communities of Ethiopia with special regard to forestry. Ethiopian Forum, vol.1, pp. 5-16.
- Broussar, Nzinga H, and Tekleselassie, T. (2012). Youth unemployment: Ethiopia country study. International Growth Center Working Paper 12/0592, August 2012, Ohio State University.
- Buffa and others (2008). California's Global Warming Solutions Act of 2006 – A background paper for labour unions (University of California, Berkeley, Center for Labor Research and Education).
- Climate and Development Knowledge Network (CDKN) (2013). NAMA proposal promoting the scaling up of biogas stoves in rural areas of Ethiopia. Draft document.
- Economic Commission for Africa (ECA) (2002). *Economic Report on Africa 2002: Tracking Performance and Progress*. Addis Ababa:
- Ethiopia Climate Innovation Center (CIC) (2011). A Business Plan for the financing and implementation of a CIC in Ethiopia. November. Washington D.C.: Information for Development of Program/the World Bank. Available from https://infodev.org/infodev-files/ethiopia_cic_business_plan_02.21.12_public.pdf.

- EEPCO (2013). Alalobad-Tendaho Geothermal Power Development Project: Environmental and Social Impact Assessment of Geothermal Sector Development for Alalobad Tendaho Geothermal Project Site, December 2013. E4392 V2.
- Ermias, Engida and others (2011). Ethiopia's growth and transformation plan: A CGE analysis of alternative financing options. Summary of Ethiopian Strategy Support Program Working Paper 30, November. Available from <http://ebrary.ifpri.org/cdm/ref/collection/p15738coll2/id/126824>.
- EthiOCAT (2010). Sustainable Land Management Technologies and Approaches in Ethiopia. The Federal Democratic Republic of Ethiopia, Ministry of Agriculture and Rural Development, Addis Ababa, 2010.
- Ethiopia, Central Statistical Agency (2004). National Statistics Abstract 2003. Addis Ababa.
- (2012). 2007 Population and Housing Census of Ethiopia: Statistical Report at Country Level, Administrative Report, April. Available from <http://unstats.un.org/unsd/censuskb20/Attachment489.aspx>.
- Ethiopia, Environmental Protection Authority (2011). Ethiopia's Climate-Resilient Green Economy Strategy. Available from http://www.uncsd2012.org/content/documents/287CRGE%20Ethiopia%20Green%20Economy_Brochure.pdf.
- Ethiopia (2010a). Forest Carbon Partnership Facility (FCPF), Draft readiness preparation proposal (R-PP) for informal submission. Country submitting the proposal: Federal Democratic Republic of Ethiopia. Date submitted (informal): 23 August 2010.
- Ethiopia, Ministry of Agriculture and Rural Development (2010b). Strategic Investment Framework for Sustainable Land Management, Addis Ababa.
- Ethiopia, Ministry of Economic Development and Cooperation (1999). Survey of the Ethiopian economy: Review of post-reform developments (1992/93-1997/98).
- (2002). Ethiopia: Sustainable Development and Poverty Reduction Programme.
- Ethiopia, Ministry of Finance and Economic Development (2010c). Fiscal Information 2010.
- Ethiopia, Ministry of Finance and Economic Development (2010d). Growth and Transformation Plan (2010/11-2014/15). Volume I: Main text.
- Ethiopia, Ministry of Mines and Energy (2008). Biofuel Development and Utilization Strategy. Available from [http://phe-ethiopia.org/admin/uploads/attachment-84-Biofuel%20Strategy%20\(English%20Version\)%20pdf.pdf](http://phe-ethiopia.org/admin/uploads/attachment-84-Biofuel%20Strategy%20(English%20Version)%20pdf.pdf).
- Ethiopian Society of Population Studies (2008). *Gender Inequality and Women's Empowerment, In-depth Analysis of the Ethiopian Demographic and Health Survey 2005*, Addis Ababa, October. Available from <http://ethiopia.unfpa.org/drive/Gender.pdf>.
- FDRE (2011), *Ethiopia's Climate Resilient Green Economy: Green Economy Strategy*, <http://www.epa.gov.et/Download/Climate/Ethiopia's%20Climate%20Resilient%20Green%20economy%20strategy.pdf>
- Food and Agriculture Organization of the United Nations (FAO) (2004). Livestock sector brief: Ethiopia". FAO Country Profiles. May. Available from http://www.fao.org/ag/againfo/resources/en/publications/sector_briefs/lb_ETH.pdf.

- (2010). Global Forest Resource Assessment. Country Report. FRA 2010/065. Rome: FAO.
- International Monetary Fund (IMF) (2008). The Federal Democratic Republic of Ethiopia: Selected issues. Series, International Monetary Fund Country Report No. 08/259. Available from <http://www.imf.org/external/pubs/ft/scr/2008/cr08259.pdf>.
- Haile, F. (1991). Women fuelwood carriers in Addis Ababa and the peri-urban forest. Report to the Government of Norway, the International Development Research Centre and the National Urban Planning Institute (Ethiopia)ion.
- Hailu, S. (1998). Hydropower of Ethiopia: Status, potential and prospects. *Ethiopian Association of Civil Engineers (EACE) Bulletin*, vol. 1, No 1.
- Gaddisa B. (2011). Biogas production system design for condominium and its feasibility. Mechanical engineering thesis, Addis Ababa University.
- Gebremedhin B. (1998). The economics of soil and water conservation investment in the Tigray region of Ethiopia. PhD dissertation. Department of Agricultural Economics, Michigan State University, US.
- Gebremedhin B. and others (2009). Sustainable land management through market-oriented commodity development: Case studies from Ethiopia. Working paper no. 21. Available from http://results.waterandfood.org/bitstream/handle/10568/2372/WP_21_final.pdf?sequence=1
- Kelbessa, E. and C. De Stoop (eds.) (2007). Participatory forest management Biodiversity and Livelihoods in Africa, Proceedings of the International Conference, 1921 March. Addis Ababa.
- Lemenih, M. (2008). Current and Prospective Economic Contributions of the Forestry Sector in Ethiopia. In: Tibebwa Heckett and Negusu Aklilu (eds.) (2009). Proceedings of Ethiopian Forestry at Crossroads: The Need for a Strong Institution, September 2008, Forum for Environment, Addis Ababa, pp. 59-82.
- (2012). The Status of Forest, Woodland, and Bush Land Resources of Ethiopia: In Sue Edward (ed) Sector Review for 2009/10, *Ethiopian Environment Review*, No. 2, 2012. 1-41.
- Luxner, Larry (2001). Ethiopian coffee: The best in the world?. African Business, February. Available from http://www.luxner.com/cgi-bin/view_article.cgi?articleID=279.
- McCann, James (1995). *People of the Plow: An Agricultural History of Ethiopia, 1800-1990*. The University of Wisconsin Press, July.
- Mengesha, Firehiwot (2008). Clean Cooking with Ethanol. Status of Biofuel Development and Uses in Ethiopia: International Workshop on Sustainable Biofuel Development, October 20-21, 2008, Addis Ababa University, Addis Ababa.
- Netherlands Development Organization (SNV) (2007). National Biogas Programme, Ethiopia: Biogas for better life. Brief programme profile, December. Addis Ababa: EREDPC. Available from file:///D:/My%20Documents/Downloads/ethiopian_national_biogas_program_2007.pdf.
- (2008). National Biogas Programme: Ethiopia, Biogas for Better Life, Programme implementation document draft.
- Nune, S., M. Kassie, and E. Mungatana (2010). Forestry resource accounting: The experience of Ethiopia. CEEPA Discussion Paper No 47, March. Centre for Environmental Economics and Policy in Africa, University of Pretoria. Available from <http://www.ceepa.co.za/Discussion%20paper%20no%2047.pdf>.

Organization for Economic Cooperation and Development (OECD) (2011). *Towards Green Growth*. Paris. Available from <http://www.oecd.org/greengrowth/48224539.pdf>.

O'Higgins, Niall (2003). Trends in the youth labour market in developing and transition countries. World Bank Social Protection Discussion Paper Series No. 0321, October. Available from http://papers.ssrn.com/sol3/papers.cfm?abstract_id=758907.

Petherick, Anna (2012). Gross domestic product is highly related to rainfall variability in Ethiopia for 1982–2000, *Nature Climate Change*, vol. 2, 29 March, pp 228–229.

Pohjonen, V., and T. Pukkala (1990). Eucalyptus globules in Ethiopian forestry. *Forest Ecological Management*, vol.36, Issue 1, pp 19-31.

Salih, R. (2002). A review of the current labour market situation, policy and programs in Sri Lanka: A paper prepared for ILO/Japan Tripartite Regional Meeting on Youth Employment in Asia and the Pacific, Bangkok, 27 February – 1 March. Available from http://www.ilo.org/public/english//region/asro/bangkok/conf/youth/con_stu/srilanka.pdf.

Stahl M. (1993). Land degradation in East Africa. *Ambio*, vol. 22, Issue 8, pp.505–508.

ECA and AUC (2013). *Economic Report on Africa 2002: Tracking Performance and Progress*. Addis Ababa.

United Nations Development Programme (UNDP) (2013). Human Development Report 2013. The Rise of the South: Human Progress in a Diverse World. New York: UNDP.

United Nations Development Programme UNEP (2011). *Towards a green economy: pathways to sustainable development and poverty eradication*, UNEP, Nairobi

Winberg, Ellen (2010). Participatory forest management in Ethiopia, practices and experiences. Food and Agriculture Organization Subregional Office for Eastern Africa (SFE), Addis Ababa, June. Available from <http://www.fao.org/forestry/24514-043adbe564e803444b40d3e18987b434d.pdf>.

Woody Biomass Inventory and Strategic Planning Project (WBISPP) (2004). Forest resources of Ethiopia: A strategic plan for the sustainable development, conservation and management of the woody biomass resources, Afar regional state. Final report, January, Addis Ababa. Available from http://www.eap.gov.et/sites/default/files/AFAR_STRAT_PLAN.pdf.

World Bank (2002). *The Federal Democratic Republic of Ethiopia: Developing Exports to Promote Growth*. Washington D.C.: World Bank. Available from <https://openknowledge.worldbank.org/handle/10986/15422>.

World Bank (2012). *Inclusive Green Growth: The Pathway to Sustainable Development*. Washington, D.C.: World Bank.