ENVIRONMENT AND NATURAL RESOURCES GLOBAL PRACTICE COUNTRY ENVIRONMENTAL ANALYSIS

GEORGIA

COUNTRY ENVIRONMENTAL ANALYSIS

Institutional, Economic, and Poverty Aspects of Georgia's Road to Environmental Sustainability

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Georgia: Country Environmental Analysis—Institutional, Economic and Poverty Aspects of Georgia's Road to Environmental Sustainability

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The Georgia Country Environmental Analysis report was prepared by a team of World Bank Group staff and consultants working on sustainable development, environment and natural resources, economic growth, and poverty reduction. The report is inspired by the opportunities that Georgia's impressive economic growth presents to drive fundamental change in the way environmental and natural resources are managed, to help reverse environmental degradation, and to demonstrate that environmental sustainability, economic growth, and shared prosperity can be mutually supportive goals.

The Bank team was led by Adriana Damianova, Lead Environmental Specialist and Task Team Leader; and Darejan Kapanadze, Senior Environmental Specialist and Co-Task Team Leader. The team is grateful for the guidance and leadership of Henry Kerali, Regional Director for the South Caucuses, and Kulsum Ahmed, Practice Manager, Global Practice on Environment and Natural Resources. The report is a synthesis of inputs of a wide range of contributors, and we would like to acknowledge all of them. A central element of the analysis is the cost of environmental degradation and the macroeconomic and poverty analysis carried out by a team of economists that include Elena Strukova-Golub, Senior Environmental Economist; Sebnem Sahin, Senior Economist; and Rodrigo Salcedo Du Bois, Economist. Gayane Minasyan, Senior Environmental Economist analyzed the public finance policies and environmental expenditures. Oleg Guchgeldiev, Economist; Alexander Arobelidze, Institutional Development Specialist; and Nana Nabakteveli, Public Finance Specialist, conducted extensive research and contributed to several chapters of the report. Gazbiah Rahaman, Communication Specialist, contributed to the production of the report. Sydnella Kpundeh, Ekaterine Asatiani, James Cantrell and Linda Starke, Editor, facilitated the preparation of the report.

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ABBREVIATIONS AND ACRONYMS

Comp: align turnover lines in tables rather than hanging them

AAP	ambient air pollution
APA	Agency of Protected Areas
BAU	business as usual
BDD	Basic Data Directions
BLL	blood lead level
CEA	Country Environmental Analysis
CENN	Caucasus Environmental NGO Network
CGE	Computable General Equilibrium
CO	carbon monoxide
CO_2	carbon dioxide
COED	cost of environmental degradation
DALY	disability-adjusted life years
ENPI	European Neighborhood and Partnership Instrument
EPI	Environmental Performance Index
EU	European Union
FAO	Food and Agriculture Organization
GDP	gross domestic product
GEL	Georgian lari (currency)
GTAP	Global Trade Analysis Project
ha	hectare
IQ	Intelligence Quotient
LEPL	Legal Entity of Public Law
MAC	maximum allowed concentration
MDG	Millennium Development Goal
$\mu g/m^3$	microgram per cubic meter
MOEP	Ministry of Environment Protection
MTEF	Medium-Term Expenditure Framework
NEAP	National Environmental Action Plan
NO_2	nitrogen dioxide
NO_x	nitrogen oxides
NPV	net present value
OECD	Organization for Economic Co-operation and Development
O_3	ozone
PE	partial equilibrium
PM	particulate matter
$PM_{2.5}$	particulate matter of size 2.5 microns or smaller in aerodynamic diameter
PM_{10}	particulate matter of size 10 microns or smaller in aerodynamic diameter
PPP	purchasing power parity
SD	standard deviation
SDG	Sustainable Development Goals
SO_2	sulfur dioxide
TSP	total suspended particles
UNECE	United Nations Economic Commission for Europe
VSL	value of statistical life
WHO	World Health Organization

EXECUTIVE SUMMARY

During the past decade, Georgia's pursuit of economic reforms led to impressive economic growth, capital inflow, and investments. It helped improve the business environment and infrastructure, strengthened public finances, and liberalized trade. Georgia achieved most of the human development targets of the Millennium Development Goals (MDGs). This progress did not result, however, in improved environmental governance or better management of natural resources.

Nowadays, environmental policies are receiving increasing attention from Georgian policy and decision makers, recognizing that sustainable development is about a profound change of policies that drive systemic transformation of production, consumption, and behavioral patterns. The list of the country's environmental challenges is long. Current policies and instruments lack the rigor to effectively reduce pressures on natural assets and protect public health from poor environmental quality. Georgia does not have a comprehensive assessment of the cost of inaction to environmental degradation linking it to economic growth, poverty, and shared prosperity. This is a central issue on which the Country Environmental Analysis (CEA) is focused.

COUNTRY CONTEXT AND CHALLENGES

Georgia is a small country endowed with valuable natural assets, magnificent landscapes, abundant water resources, rich habitats, and pristine ecosystems that are of regional and global importance. Many areas need attention and actions that should go beyond traditional environmental mainstreaming.

- » Nearly three-fourths of Georgians are exposed to high levels of particulate matter in the air in cities, where they face increased risks of cardiovascular disease, chronic obstructive pulmonary disease, and lung cancer.
- » Half of the population lives in rural areas, where four out of 5 households use solid fuel for heating and cooking; most of the people in these households are exposed to indoor air pollution at levels on average 30 times above the recommended level.

» Children are at heightened risk of loss of cognitive abilities because of high levels of lead, despite the official ban on lead in fuels since 2000.
» Waste management remains a problem for cities except in Tbilisi and Rustavi.
» Over the past 12 years, forest cover has been reduced by 7,800 hectares (ha), and Georgia has gained 4,900 hectares of forest of a different quality.
» Two-thirds of agricultural lands are eroded or degraded; loss of land productivity because of degradation and the increased frequency and magnitude of floods, landslides, and mudflows greatly affects people in rural areas.
» From 1995 to 2012, floods and erosion—particularly through landslides and mudflow—led to US$650 million in economic losses.
» The national environmental monitoring system has limited capacity to effectively address data information gaps and effectively support policy and decision making and curb pollution.

Low-income groups are disproportionately at risk of the effect of environmental degradation. It is estimated that 77 percent of the total number of new poor individuals in Georgia, because of natural disasters, will live in rural areas. Their dependence on natural resources for fuel wood and the lack of alternatives indicates that the pressure on the environmental resources is likely to continue. Hence, impacts occur from the use of solid fuel such as high levels of indoor air pollution affecting health and pressure on forests that reduces their capacity to capture carbon. Without effective policies to reverse environmental degradation, these risks are likely to remain relatively constant.

Recent years have witnessed a stronger recognition of national environmental challenges. Many of the reform measures undertaken recently by the government are commensurate with the scale of environmental challenges and are broadly aligned with national socioeconomic development goals. Georgia's Socio-economic Development Strategy 2020 sets forth three main principles: boosting productive sectors of economy, fostering inclusive growth and social equity, and ensuring environmental safety and sustainability through the prevention of natural disasters and the rational use of natural resources. Sustainable development is a priority reflected in the National Indicative Program as a milestone of the deepening integration with the European Union (EU).

COUNTRY ENVIRONMENTAL ANALYSIS—OBJECTIVE, SCOPE, APPROACH, LIMITATIONS

The main objective of the CEA is to assist the government, civil society, and development partners of Georgia in identifying and analyzing critical environmental constraints to sustainable growth and shared prosperity. An important part of the analysis is an evaluation of general and direct impact of environmental degradation, expressed through the cost of inaction, on short-term and medium-term productivity of the economy and possible distributional impacts on different income groups. To meet its objective of informing the economic growth dialogue, the CEA—to the extent possible—integrates economic development with environmental and social aspects in order to foster an understanding of unsustainable patterns of development and the effects of environmental degradation on economic growth. The CEA identifies key institutional capacity gaps for implementing actions to reverse environmental degradation, including through the current budget system of financing environmental expenditure.

Drawing on all this, the report provides recommendations for reversing environmental degradation that are multiscale in nature and involve cross-sectoral interventions. The report covers only selected areas given the resource constraints and data fragmentation. The areas studied in the CEA include ambient and indoor air quality, waste management, degraded agricultural land, forest and landscape management, and the effects of natural disasters where dependence of poor people on natural resources and their vulnerability to degraded environment and health risks indicate the need of a stronger policy response. In particular, the CEA covers in a more exhaustive fashion sectors where environmental challenges could be defined by using readily available sources, allowing data validation through interviews or consultations with stakeholders beyond sector and institutional boundaries. Although a considerable amount of quantitative and qualitative data were compiled, limitations resulting from data gaps prevented analyses beyond the above areas. Further prioritization and sequencing of the indicative list of recommended actions produced by the CEA would benefit from a cost-benefit analysis (CBA) of the long list of actions. Such an approach would have to be supported by a comprehensive monitoring and data collection at microlevel.

The CBA would also facilitate better planning of policy measures and resources for implementation.

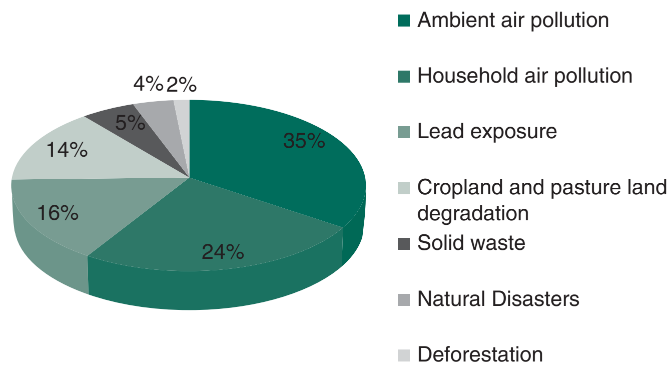
WHAT IS AT STAKE?

The CEA used the best available evidence that could be mobilized to describe the underlying concerns of environmental-health damage and to quantify the cost of inaction and related impacts on economic growth and the poor in selected areas. The results are formulated to possibly enhance the analytical underpinnings of the national environmental management policies. The following highlights support the argument that it is necessary to adequately weigh the benefits of economic deregulation against the repercussions of poor environmental quality on public health.

The annual loss as a result of the human health effects of ambient air pollution (AAP), household air pollution, exposure to lead, land degradation and deforestation, loss of amenity from untreated solid waste, and natural disasters expressed as a percentage of gross domestic product (GDP) was 7.4 percent in 2012. This amounts to a potential loss of Georgian lari (GEL) 2 billion. Land degradation as a result of floods, wind erosion, overgrazing, and progressive loss of vegetation in 2012 alone resulted in a loss of crop production estimated at about US$87 million (figure ES.1).

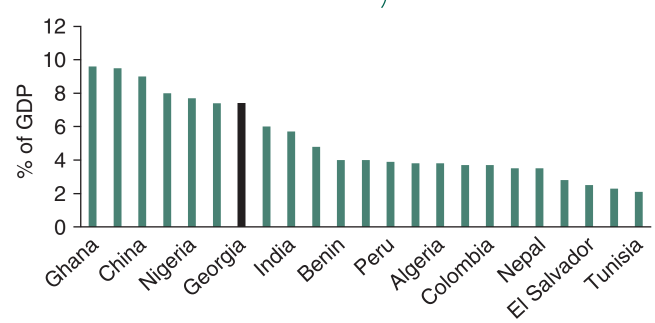
Compared with other countries where the World Bank has conducted similar studies, Georgia's loss is in the higher range. In 2012, some 35 percent of damages were caused by ambient air pollution (in terms of percentage of GDP), 24 percent by household air pollution, 16 percent by effects of lead, and 14 percent by land degradation. The total estimate of costs of inadequate solid waste regulation is in the range US$57–US$64 million, or about 0.4 percent of GDP in 2012 (figure ES.2).

FIGURE ES.1. SHARE OF COSTS OF ENVIRONMENTAL DEGRADATION BY SECTOR, 2012



Source: Estimated by authors.

FIGURE ES.2. COST OF ENVIRONMENTAL DEGRADATION (HEALTH AND NATURAL RESOURCES DAMAGES)



Source: Estimated by authors, World Bank 2012.

On average, Georgia's annual growth rate, which is projected at 4.55 percent in 2013–16, could lose 1.36 percentage points each year because of chronic air pollution problems. Thus, the average annual growth rate adjusted for the cost of environmental degradation (COED) would be only 3.19 percent, which is below the projected world growth rate of 3.62 percent for the same period. Based on modeling results, Georgia's economic performance could further be reduced to 2.94 percent when the risk of a high-intensity natural disaster event is taken into account.

The total annual cost of natural disasters (physical damages and causalities) is estimated at US$24–US$117 million or

0.2–0.7 percent of GDP in 2012. Macromodeling results show that a 50-year disaster event could reduce the annual growth rate by 1.49 percentage points. In the event of such a high-intensity natural disaster, the agricultural sector—where one-quarter of the unskilled, low-income workers are active—would face a negative growth rate of 1.26 percent. The cost of a major natural disaster would mainly affect rural households. The poverty rate in rural areas would change from 18.9 percent to 19.6 percent, and 10,564–24,138 people would become newly poor. Also, the poverty gap, which measures the additional consumption that the poor need to reach the poverty line, would increase from 1.7 percent to 6.3 percent.

POLICIES AND INSTITUTIONAL FRAMEWORK

Overall, Georgia's environmental legal framework is well developed and covers key aspects of environmental protection legislation. In conjunction with the provisions of the EU-Georgia Association Agreement, Georgia has started to harmonize the legal basis concerning environmental management and, most important, to integrate environmental concerns into other policy areas.

The introduction of impact assessment and environmental classification of activities based on their scope and risk levels, along with a ruling in the strategic environmental assessment of regional and sectoral development programs, is imperative to set the stage for assessment of project impacts across all sectors. A few types of high-risk activities such as exploration and commercial mining that are not subject to environmental assessment at present need to be included in the legal provisions for impact assessment. It is especially important to focus on policy and legislative improvements where the effect would have to be measured in terms of reduced pollution levels and reversing the scale of resource depletion.

A new Forest Law is being developed, translating the policy approach provided in the recently adopted National Forestry Program. The Law on Water Resources Management, also currently in development, is expected to provide the basis for sustainable watershed management. The Waste Code, which has been in effect since January 2015, defines the responsibilities of various institutions and entities for waste management.

When vital functions of the Ministry of Environment and Natural Resources Protection were reinstated in 2013, its responsibilities and overall budget increased significantly. Although this was a welcome move, important administrative functions—for instance, issuing environmental permits and licenses—need to be supported by institutional capacity. Central to institutional and regulatory reforms are the incentives for administrators to effectively enforce policies and regulations, increase implementation transparency, and involve the public.

Significant improvements will be necessary in the national environmental monitoring system to improve the quality of data and to address data and information gaps. Georgia has to adopt adequate pollutant standards for air, water, soil, and waste, along with time-bound targets for their achievement. Implementation of ambient air quality standards based on the World Health Organization (WHO) should focus on substances that affect human health the most. Currently, a series of regulations are awaiting revisions in order to align with good international practice and national targets of environmental quality. There is a pressing need to adopt internationally accepted methodology for monitoring ambient air quality, establishing acceptable levels of pollution, and regulating discharges of various types of pollutants in the environment.

Current strategies and policies need a greater focus on the estimation of benefits (such as health benefits, productivity benefits, and amenity benefits). This would increase the possibility of targeted use of budget resources to neutralize the negative consequences on human health, especially when public resources are in high demand by various sectors.

Given the amount of environmental problems in Georgia, budget resources fall short of what is needed to combat environmental degradation. Spending by the main ministries responsible for environmental protection during 2009–13 amounted to an average of just 0.37 percent of total government expenditures, despite the fact that since 2012 the government has defined environmental protection as one of its priorities. The Medium-Term Expenditure Framework (MTEF)/Basic Data Directions (BDD) also declares environmental protection a priority. Yet the budget/expenditure for 2011–13 was lower than it was for 2009–10. During the same period, public environmental expenditures as a percentage of GDP decreased from 0.2 percent to 0.09 percent. Compared with other countries, particularly those in Europe, Georgia spends considerably less on environment as a percentage of GDP. Rebalancing budget allocations to areas that appear of significant concern such as air quality, land degradation, and solid waste management could allow Georgia to align expenditures with policy priorities and achieve sustainable outcomes.

The success of environmental policies and regulations with economywide and societal benefits is also determined by various incentives or penalties that can be used effectively to influence economic and human behavior. Georgia's system for natural resource fees and fines has to be improved in order to maintain adequate incentives for users and polluters to reduce environmental pressures. This means monitoring and assessing the effectiveness of economic instruments involving payments most commonly in the form of taxes, permits, and rent as well as government payments in the form of subsidies and other transfers. For natural resources used commercially, there are untapped opportunities for more effective controls and payments for their use, which could also call for reform of the system of environmental taxes.

Georgia needs to expand further the policy debate on environmental factors in sustainable development in order to deliver on the priority actions outlined in the government's Basic Data and Directions for Development and to meet the environmental sustainability goals in MDG No. 7. Having embraced the paradigm of unified economic, environmental, and social development, Georgian policy makers need to act to minimize environmental degradation and human health risks. The next step would be to track progress on national strategic goals by benchmarking them to internationally accepted indicators of sustainable development and to assess national policy in a complex manner, considering fundamental economic welfare and intergenerational aspects.

THE NEED FOR ACTION

Timely actions to reverse the current course of affairs would reduce the underlying risks to Georgia's economic growth and would set the country on the road to sustainability. The following indicative list of actions draws on the CEA. This list could serve as a blueprint for actions to address the issues studied in the CEA and could further benefit from carrying out a cost-benefit analysis of recommended measures in order to prioritize and determine their sequence and allocate budget resources. These actions, if implemented consistently, could reinforce in a positive way the sustainability profile of Georgia.

IMPROVE AIR QUALITY

- Strengthen the current system of *air quality monitoring* by expanding air quality monitoring parameters/pollutants where the highest health impacts are observed; break down emission monitoring into particulate matter of size 2.5 microns or smaller in aerodynamic diameter ($PM_{2.5}$) and particulate matter of size 10 microns or smaller in aerodynamic diameter (PM_{10}); introduce continuous monitoring for lead rather than monthly averages of discrete 20-minute measurements; monitor ground-level ozone at more stations in cities.
- Reestablish a fiscally neutral (from a public finance point of view) annual *vehicle technical inspection system* with the necessary diagnostic equipment and technical staff; reintroduce vehicle registration and licenses to encourage adherence to emission standards and improvement of air quality.
- Introduce a system for regular *monitoring of fuel quality* at retail stations for lead content; limit sulfur in gasoline and diesel to a level compatible with the EU standards.
- Reform the current *system of pollution charges* for air, water, and generation of waste.

REDUCE HEALTH IMPACTS FROM POOR INDOOR AIR QUALITY

- Expand programs for *reducing the use of household biomass fuels* for heating and cooking and address health risks associated with poor indoor air quality from open fires and traditional stoves especially in rural areas.
- Develop policy on climate change mitigation and actions on *clean household energy* to maximize health and climate gains.

IMPROVE SOLID WASTE MANAGEMENT

- Promote innovation and adoption of effective *solid waste management* through commercial applications and through market forces for reduced waste generation and disposal.

- Reduce the *number of waste dumps* and the share of material assets and population at risk of exposure to untreated waste.
- Tighten the relationship between *public investments* in environmental infrastructure and national sustainability goals.

MANAGE FOREST RESOURCES

- Adopt the new *Forest Law*, with adequate provisions for forest monitoring and management.
- Arrest forest loss and degradation of forestlands by reconciling the high demand for fuel wood in rural areas through expanding programs for *cleaner stoves and renewable energy in remote areas* and through developing sustainable scenarios for commercial production of timber and control of the transformation of land under forests.

REDUCE IMPACTS OF EXTREME WEATHER AND ARREST LAND DEGRADATION

- Strengthen economic incentives and governance structure for nature protection and support for activities aiming to *mitigate land degradation and desertification* in areas prone to natural disasters.
- In agriculture, promote *adoption of drought-resistant cultivars*.
- Introduce better coordination at the institutional level to *improve the weather hazards early warning and response*.
- Expand the modernization of the *hydrological and meteorological observing network*.
- Consider targeted support to poor populations through the *social protection system for mitigation of natural disaster impacts*.
- Expand the index based *weather-related disaster insurance system* to protect the most vulnerable parts of the population.

ENHANCE ADMINISTRATIVE AND INSTITUTIONAL CAPACITY FOR POLICY IMPLEMENTATION

- Initiate capacity building for *environmental statistics* to ensure accuracy of data collection of environmental monitoring, including for reporting to meet regional and international conventions.
- Strengthen the basis for policy development by adopting the methods and definitions used to generate *green accounts*, in which monetary values are attributed to physical accounts, and monetary "stock" and "flow" accounts cover different types of natural capital.

Which policies and actions are the most effective, economically efficient, administratively feasible, and politically acceptable to resolve Georgia's current environmental degradation problems? Countries that have addressed similar problems and improved environmental management systems have created an enabling governance framework through coordination and cooperation among various stakeholders and through clear regulatory mandates. Incentives for behavioral changes need to be supported by strong implementation mechanisms and regular evaluation. Successful strategies to mitigate environmental degradation have to incorporate quantitative targets in the national laws and programs across sectors. Georgia should take advantage of the international cooperation and financing that can be a major source for transfer of new environmental management "know-how," efficiency improvements, and knowledge of clean development.

As Georgia moves toward sustainable development, it will further benefit from a comprehensive national strategy that combines "green growth" and development with the efficient use of natural resources and environmental services. Planning investments and promoting innovations will contribute to sustainable growth in the medium run and will create new economic opportunities. "Green growth" could lay a foundation for mutually reinforcing economic and environmental policies, taking into account a full value of natural capital as a factor of production and for its role in growth. The transition to a new pattern of growth will include cost-effective ways to mitigate environmental pressures and to avoid crossing critical local, regional, and global environmental thresholds. Mitigation of environmental and natural resource degradation will foster economic growth in the long run and promote poverty alleviation, as poor populations are the people who suffer the most from polluted localities and natural resource degradation.

CHAPTER ONE
INTRODUCTION

Georgia has a small middle-income economy that grew at a steady pace of an average of 6.1 percent a year during 2003–12 (see table 1.1). The past decade has been marked by a pursuit of broad economic reforms that stimulated capital inflow and investments, improved the business environment and infrastructure, strengthened public finances, and liberalized trade. Although the GDP remains among the lowest in Europe and Central Asia, the GDP per capita increased from $920 in 2003 to $3,500 in 2012. Because of this economic transformation, in 2012 unemployment fell to 15 percent and poverty rates to 14.8 percent. In contrast, Georgia fares poorly on the World Bank's measure of shared prosperity: consumption of the bottom 40 percent of the population grew at only 0.7 percent per year compared with 2 percent for the overall population in 2006–08. In 2012, about 14 percent of the population lived on less than US$1.25 per person per day, and 78 percent lived on less than US$5 per person per day (World Bank Country Partnership Strategy for 2013–17, World Bank Staff calculations, Integrated Household Survey). Georgia is on track to achieve several of the Millennium Development Goals by 2015. There has been progress with infant and maternal mortality, full enrollment in primary education, a higher ratio of girls to boys in primary and secondary education, and an increased proportion of the population with access to safe water sources.

Despite the marked success of the structural reform, little attention has been paid to public policies to protect the environment and manage natural resources sustainably. Notwithstanding recent positive administrative and legislative developments, environmental policies remain driven by excessive deregulation exacerbating existing problems and resulting in growing pressure on natural resources and unaddressed environmental damage. People in Georgia are exposed to one or more major environmental health risks. Some 73 percent of the population is estimated to be exposed to high levels of particulate matter ($PM_{2.5}$); another 27 percent are also exposed to air pollution, but at a lower level. Ambient air quality in many Georgian cities has deteriorated, and people in Tbilisi, Kutaisi, and Batumi are exposed to dust, carbon monoxide (CO), and nitrogen and sulfur dioxides (NO_2 and SO_2) that exceed the maximum allowable concentrations and (WHO) standards. Although lead concentrations occasionally measured in Tbilisi did not exceed the

TABLE 1.1. GDP OF GEORGIA AND SOME KEY ECONOMIC INDICATORS, 2006–12 (NOMINAL AND REAL GDP)

	2006	2007	2008	2009	2010	2011	2012
GDP in current prices, million GEL*	13,789.9	16,993.8	19,074.9	17,986.0	20,743.4	24,344.0	26,167.3
GDP in constant 2003 prices million GEL	10868.0	12,208.8	12,491.4	12,019.7	12,771.3	13,687.5	14,637.7
GDP real growth (%)	9.4	12.3	2.3	−3.8	6.3	7.2	6.4
GDP per capita (current prices), GEL	3,133.1	3,866.9	4,352.9	4,101.3	4,675.7	5,447.1	5,818.1
Exchange rates USD/GEL (Year average)	1.77	1.67	1.49	1.67	1.78	1.68	1.65
GDP per capita (current prices), USD	1,763.5	2,314.6	2,921.1	2,455.2	2,623.0	3,230.7	3,523.4
GDP in current prices, millions USD	7,761.7	10,171.9	12800.5	10767.1	11,636.5	14,438.5	15,846.8
FDI (millions USD)	1,190.4	2,014.8	1,564.0	658.4	814.5	1117.2	911.6
Unemployment rate (%)	13.6	13.3	16.5	16.9	16.3	15.1	15.0

Source: National Statistics Office of Georgia, http://geostat.ge.

* Georgian lari, the national currency of Georgia. Exchange rate in December 2012 was US$1 = GEL 1.66.

national maximum allowable concentration of 0.0003 mg/m^3 since 2009, health effects from prior exposure to lead are estimated to be significant and definitive, especially for children. The mean annual concentration of sulfur and manganese dioxides exceeds permissible levels in Zestafoni. The *State of the Environment of Georgia* report (2007–09) notes that vehicle transport is the main source of air pollution. Road transport is responsible for over 90 percent of the emissions to air of nitrogen oxides (NO_x), NO_2, volatile organic compounds (VOC), and CO within Tbilisi. In addition, road transport is responsible for 67 percent of all PM_{10} emissions and 83 percent of all SO_2 emissions. The number of registered motor vehicles (passenger cars, trucks, and buses) in 2008 was 20.7 percent above the figure in 2004. Monitoring data from the National Environmental Agency show that air quality in Tbilisi, where almost one-third of the total motor transport is concentrated, has deteriorated the most.

Between 70 percent and 80 percent of the rural population uses solid fuels for cooking and therefore is likely to be exposed to household air pollution levels on average 30 times over the minimum level (Guntsadze and Tsakadze 2014). Despite the recent progress in addressing solid waste management in large cities, 28 unregulated waste dumps remain an ongoing concern as a source of uncontrolled local pollution.

About 35 percent of the agricultural lands in Georgia are degraded. Land erosion is a major problem on more than 1 million hectares of land, including on 380,000 hectares of cropland. Uncontrolled felling of floodplain forests to use as fuel wood, overgrazing, and destruction of wild shelter belts are among the key causes of land desertification. About 4 percent (3,000 sq km) of the country is vulnerable to desertification.

The list of unresolved environmental problems is clearly long. In order to balance short-term economic gains with long-term sustainable development and make further progress on poverty reduction and human development, Georgia needs measures that will help overcome key environmental problems, especially those presenting a constraint to poverty reduction and growth, as well as significant public health concerns. Measures to improve the management of the environment and natural resources will require public resources. Relatively high rates of economic growth during the past decade could set Georgia on a "fast track" to mobilize direct resources and achieve measurable improvements.

To date, Georgia's environmental priorities are commensurate with the scale of environmental challenge and are broadly aligned with the national socioeconomic development goals. Yet there are many challenges to be addressed in order to prevent environmental degradation. Georgia's small territory of 69,700 sq km is endowed with diverse landscapes and valuable natural assets extending from the shores of the Black Sea to the peaks of the Western Caucasus. The country enjoys abundant water resources, rich habitats, and pristine ecosystems that are of regional and global importance. At the same time, it is among the most vulnerable countries to climate change in Europe and Central Asia (ranking number 5) and with lower adaptive capacity. Key areas needing priority attention include air and water quality, waste management, land and landscape management, coastal and marine protection, chemicals management, and natural resources use and protection. Institutional and administrative capacity for environmental protection needs strengthening with regards to capacity to assess and manage environmental risks and impacts, strategic planning, implementation and enforcement of regulations, and environmental awareness.

The ongoing convergence of national environmental policies with EU Environmental *acquis* is an opportunity for improving the policy and regulatory foundations for sound environment management. The key policy documents showcasing Georgia's commitment to environmental priorities are the Government Program for Strong, Democratic, United Georgia, endorsed by the Georgian Parliament in October 2012, the National Environmental Action Plan (NEAP, 2012–16), the Government Program Basic Data and Directions for Country Development 2014–17, and the EU-Georgia Association Agreement, signed in June 2014. Although linkages between economic development and environment are explicitly recognized in these documents, the dependence of poor people on natural resources and their vulnerability to degraded environment and health risks needs stronger policy emphasis. The interface between environmental and economic policies is a two-way street. Over time, environmental management policies aiming to address environmental issues could lead to economic efficiencies if the constraints to their implementation were addressed. Georgia does not have a comprehensive assessment of the priority environmental concerns and linkages with economic growth, poverty, and shared prosperity. This is the focus of the Country Environmental Analysis.

The Ministry of Environment and Natural Resource Protection of Georgia (MENRP), with the support of the World Bank, initiated the preparation of the CEA, aiming to link economic development, environmental sustainability, and poverty reduction and to close the existing knowledge gap. The CEA offers highlights and recommendations to Georgia's decision makers in support of the process of policy prioritization to address environmental challenges.

OBJECTIVE OF THE STUDY

Georgia's Country Partnership Strategy for 2014–2017 (Report 85251-GE from June 2014) points to lagging public policies on protecting the environment and natural resources, against impressive economic growth. It further highlights several areas needing attention, such as air and water quality, waste management, land and landscape management, and nature resource use and protection.

The main objective of the CEA is to assist the government, civil society, and development partners of Georgia in identifying and analyzing critical environmental constraints to sustainable growth and shared prosperity. More specifically, the CEA aims to:

- » Broaden the level of policy dialogue on environmental challenges and measures for addressing them by showcasing that delaying policy action has an economic and social cost
- » Establish a set of development priorities based on the state of the environment and estimates of current cost of environmental degradation and policy actions for addressing key environmental issues
- » Identify the institutional capacity gaps to implementing these actions, including through the current budget system of financing environmental expenditure.

An important part of the analysis is an evaluation of general and direct impact of environmental degradation on short-term and medium-term productivity on the economy along with the distributional impacts on different income groups. Specifically, the CEA assesses the direct impact on GDP associated with local emissions in terms of mortality and economic performance, the impact of lead exposure on productivity, and the damage to assets in the medium term caused by natural disasters.

METHODOLOGY AND LIMITATIONS

In the design and preparation of the CEA, several standard diagnostic tools were used. This includes a literature review to identify the extent of environmental problems in selected areas, agreement with stakeholders on the priority areas of the analysis, and data collection followed by quantification of the problem through assigning monetary value to environmental degradation. Most of the data were collected in 2013–14 through reviews of documents, reports, and other materials, including Internet sites and maps; field interviews; and official government sources. Monitoring of data from national sources was used where available despite the challenges related to observation methods and coverage.

The methodology for calculating the COED applies a bottom-up approach for quantifying the cost of inaction by ranking relative social costs of various forms of degradation and expresses the damage costs as a percentage of GDP, allowing for comparison with other economic indicators. Valuation methods range from market pricing (for example, to estimate the reduction in land/housing values because of polluted sites) to demand curve approaches and nondemand curve approaches (for example, the decline in health because of air pollution can be valued by using the cost of illness approach). In terms of the linkage between degradation and health effects, first-dose response and exposure response functions are used, based on data on emitted pollutants and ambient air concentration data. The health effects of pollution are converted to disability-adjusted life years (DALYs) to facilitate a comparison between different health effects. Based on estimated annual costs of illness, the monetary impacts are determined. The health impact of air pollution concentrations is estimated based on the pollution loads and contributions to air pollution concentration from different sources.

The COED involves a three-step process:

- » Quantification of environmental degradation (for example, monitoring of ambient air quality, river/lake/water quality/soil degradation
- » Quantification of consequences of degradation (health impact, changes in soil productivity, changes in forest density/growth, reduced natural resource–based recreational activities, reduced tourism demand)
- » Monetary valuation consequences (estimates of the cost of ill health, soil productivity losses, reduced recreational values).

The CEA used available sources to assess the overall institutional gaps and the adequacy of public financial resources to address key environmental challenges. The review of environmental public expenditure is based on the Medium-Term Expenditure Frameworks/Basic Data Directions (MTEF, BDD) and official expenditure reports. The review looks into the environmental investment priorities and resource allocations and how these are aligned with the objective to maximize potential public benefits.

The macroeconomic analysis uses a static computable general equilibrium (CGE) model developed for Georgia (based on Global Trade Analysis Projecct [GTAP] data, 2011) and a partial equilibrium (PE) model to analyze potential impacts on poverty. Based on the macroeconomic impact of environmental degradation estimated for 2012, the study prioritizes across sectors (energy, transport, urban, and agriculture) a number of policy interventions that in the short term (2014–15) could support actions toward inclusive, efficient, clean, and resilient growth in Georgia. The cost of environmental degradation is an input for the macroeconomic impact analysis; description of the economywide analysis (CGE) and the partial equilibrium model are used to estimate the environmental degradation's impact on the poor. The CEA studies the relationship between poverty and environmental degradation from natural disasters (excluding earthquakes) by using ADePT simulation method (Olivieri et al. 2014) to assess the effect of degradation on poverty. The CEA simulates the effect of natural disasters on poverty using both the results of the CGE model (nonlevel) combined with household data from the Integrated Household Survey of Georgia of 2012 (microlevel).

Given the lack of data on specific drivers of environmental degradation at the household level, the analysis relies on simulation methods. These methods have several caveats, but in some cases they are very useful for providing a general idea of the potential effects of environmental degradation on poverty. In that sense, the results from the CGE model were integrated with microdata to simulate these effects.

A detailed description of the three steps methodology is described in details in appendix B.

The CEA report aims to strike a balance between breadth and depth, given the resource constraints, data fragmentation, or lack of data. In particular, the CEA covers in a more exhaustive fashion sectors where environmental challenges could be defined and prioritized by using readily available sources allowing validation through interviews or consultations with stakeholders beyond sectors and institutional boundaries. For the CEA report, the definition of *environment* includes several elements of the physical environment (air, land, forests) and impacts that can be modified by short-term or medium-term interventions to reduce the human health impact and economic cost. Although considerable quantitative and qualitative data were compiled for the preparation of the study, certain limitations remained to expanding the analysis. Where estimates and international comparators were used for the analyses, these were cross-checked with relevant and knowledgeable parties and adjusted accordingly. Therefore, it should be understood that some assumptions are associated with varying uncertainty. The study identifies areas for future research to help stimulate further the debate on sustainability and expand the policy-driven platform of growth and environmental sustainability.

STRUCTURE OF THE REPORT

This opening chapter has outlined the country context and rationale for the CEA, elaborated on the methodology and limitations, and set the background for the rest of the report by highlighting key challenges of the state of the environment of Georgia.

Chapter 2, Key Environmental Challenges, identifies the main challenges and pressures on the environment and natural resources, elaborates on the causes of the current problems and remaining issues, benchmarks Georgia's performance on MDGs and the Environmental Sustainability Index, and highlights the areas and priority actions to mitigate current pressures.

Chapter 3, Valuation of Environmental Degradation—Challenges and Opportunities to Change the Course, describes the cost of environmental degradation for 2012. This includes insights into the relative magnitude of the problem, economic and health impacts of air pollution, forest loss, land degradation, natural disasters, and waste. The sectors that are analyzed were selected in agreement with the government based on the following: sectors where current unmitigated pressure on resources have prospects to accelerate with future economic growth, sectors where environmental issues are of intersectoral nature and their resolution will require significant improvements in the institutional coordination and financing responsibilities, and sectors and issues given priority as health and well-being have established relationships between levels of pollution and certain human health "end effects," such as premature mortality and morbidity. Chapter 3 also analyzes the impacts of lead exposure and multiple health risks linked to cognitive impairment, cardiovascular effects, low birth weight, diminished life expectancy, and so on.

Chapter 4, Macroeconomic Dimensions of Environmental Degradation, discusses environmental degradation in relation to economic growth and to the poverty profile of the country concerning natural disasters. It takes the analysis to a nonlevel to assess general and direct impacts on the economy of Georgia using a CGE model that was developed for Georgia, simulating the Georgian economy under three scenarios for 10 sectors. The overarching causes for concern include evidence that concerns the poor and how they are affected by depreciation of natural assets that are not always factored in when establishing priorities for policy actions to address environmental degradation.

Chapter 5, Political Vision, Policy, and Institutions, presents an overview of the policy and institutional establishment; discusses current policies, regulations, and gaps; and points to the strategic drivers and government priorities for addressing environmental issues. The chapter concludes with an assessment of environmental public expenditure and needs. It also discusses policies and institutional performance issues that could benefit from certain improvements. The review of the public environmental expenditures makes recommendation for shifting resources to priorities where the cost of environmental degradation is high and risks to public health remain unresolved.

Chapter 6, Caring about the Environment and People—The Way Forward, summarizes priority recommendations and cross-cutting themes and proposes a number of policy and regulatory actions to minimize economic and societal losses related to environmental degradation. Many of these focus on areas where the overall effectiveness of Georgian environmental institutions and management could be strengthened further. It highlights the areas where the current system of environmental management and public finance needs improvements in order to align environmental governance with stated economic development priorities and the well-being of Georgian people.

CHAPTER TWO

KEY ENVIRONMENTAL CHALLENGES

LAND DEGRADATION

Georgia has limited land resources. The total agricultural land is 32,000 sq km, accounting for 40 percent of the country's total territory, of which about 30 percent (10,700 sq km) was cultivated in 2005. Some 65–70 percent of the country has poor soils with insufficient nutrients to support agricultural crops. Soils differ markedly among the west, east, and south of the country: lowland wetland, mountain-forest, and mountain-meadow soil zones are prominent in the west, whereas chestnut and black soils in the steppes and brown soils (in the Eldari semidesert and various areas of the southern parts of Iori upland) are typical for the eastern province (Georgia Fourth National Report to the Convention on Biodiversity Conservation).

Poor land management practice, soil erosion, salination, and loss of vegetation cover exacerbate the process of land desertification and have resulted in degradation of almost 35 percent of the farmland. There is no systemic monitoring of soil pollution. Because of land degradation, ecosystems fail to deliver such services as flood control and prevention of frequent disasters caused by landslides and flash floods. Georgia is experiencing a significant increase in the frequency and intensity of extreme hydrological and meteorological events, including geological disasters. Erosion and loss of land productivity have been worsened by natural extreme events, by human activities, and by unsustainable mining and construction (for example, hydropower infrastructure), uncontrolled logging, overgrazing, poorly regulated urbanization, industrial activities in riverbeds, and a lack of compliance with land use regulations and with environmental and hydrological standards, coupled with the impacts of climate change.

Years of unsustainable mining practices of Georgia's rich mineral resources (gold, copper, manganese, and zeolites) have caused soil and groundwater contamination, creating an eyesore of multiple abandoned mining sites, and have left the state with environmental liabilities requiring costly cleanup and a contingent liability for the public finances. Nationally, out of the 1,500 ore and mineral deposits with high potential for industrial exploitation, 675 are currently being exploited—including 29 percent of the country's estimated groundwater reserves.

There are many problems with the forest sector because of unsustainable management practices and lack of transparency. Georgia's highly diverse forests cover 29,000 sq km, 39 percent of its territory. The Georgian parliament adopted the New National Forest Policy Document (the National Forestry Program) in December 2013, which significantly changed the strategic framework of forest management. The National Forestry Program promotes sustainable forest management, aiming to ensure improvement of qualitative and quantitative indices of the Georgian forests; to strengthen biodiversity protection and efficient use of forests' economic potential, taking into account their ecological value; and to expand public participation in forest management and equitable distribution of benefits. Based on the National Forestry Program, work on a new Forest Law started in 2014.

Although it is recognized that a disproportionate emphasis on logging has thwarted progressive regulatory reforms in the sector, finding an adequate policy solution to forest management remains a pressing issue at the national level. A high turnover of forestry officials, a series of institutional reforms, and various legal reforms have not had tangible results. Unsustainable forest and pasture management practices and weak enforcement accumulated serious problems, which in combination with widespread poverty in mountainous areas affect the ability of mountainous ecosystems in the long run to provide basic ecosystem services (for example, regulate water runoff and climate, sustain vegetation cover and fish stock). This in turn would affect local economic development and livelihood opportunities in these areas.

Fires have become an increasing threat to forests, protected areas, and other vegetation resources in Georgia because of climate change and certain land use patterns. Even though the annual average number and extent of forest fires for the last decade is believed to be moderate, some large fires in recent years—in 2006 (765 hectares [ha]), 2008 (1270 ha),[1] and 2010 (430 ha)—revealed the high risk of large-scale disasters during dry seasons.[2] In total, 2005 ha of forest have been degraded during past three to four years because of forest fires.[3]

CLIMATE-RELATED NATURAL DISASTERS

Georgia has an average rainfall of 1,026 mm/year, defining two distinct climatic regions. Western Georgia has a subtropical humid climate, mild winters, and not very hot summers. The average precipitation is estimated at between 1,100 and 1,700 mm/year. Average temperatures vary between 5°C in January and 22°C in July. Eastern Georgia has a subtropical dry climate, with fairly cold winters and arid, hot summers. The average precipitation varies between 500 and 1,100 mm/year. About 80 percent of the rainfall occurs from March to October, and the longest dry period is about 50–60 days. Droughts are common. Hail occurs in spring and autumn. Average temperatures vary between −1°C in January and 22°C in July. Floods and flash floods resulting from heavy precipitation or sudden releases from upstream impoundment created behind dams, landslides, or glacier melt occur in mountainous areas and lowlands. The National Environmental Agency recorded 164 flood and flash flood events and 24 casualties, amounting to GEL 435.7 million between 1995 and 2010.

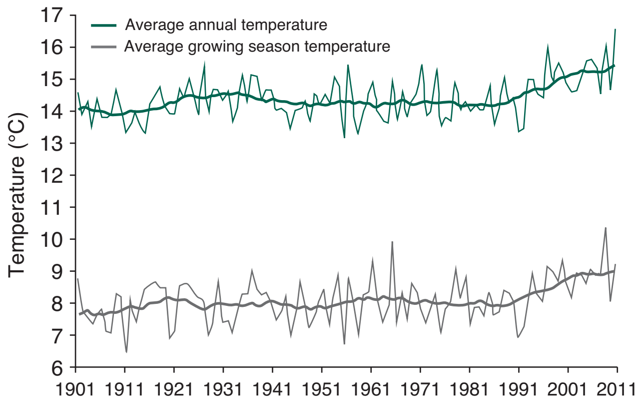
Multiple occurrences of weather-related hazards in the past decade signify Georgia's inherent susceptibility to natural disasters. Global effects of climate change are expected to exacerbate the frequency and magnitude of hydrological hazards in the South Caucasus region. Trends reported in the Second National Communication of the UN Framework Convention on Climate Change show that average temperatures in Tbilisi increased by 0.7°C over the past century (see figure 2.1) and by 0.5°C in Eastern Georgia, but that there was a slight cooling in Western Georgia. Precipitation has increased in the lowland areas of Georgia by about 10–15 percent and has decreased in mountain areas by 15–20 percent (National Climate Research Centre 1999). The Second National Communication from Georgia identifies three areas as the most

[1] This does not include forest areas burned because of military activities during the 2008 war.

[2] Proposal for a National Fire Management Policy of Georgia, ENVSEC project "Enhancing National Capacity on Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus."

[3] National Biodiversity Strategy and Action Plan 2014–2020, approved by Government Resolution N343 of 8 May 2014.

FIGURE 2.1. GEORGIA AVERAGE ANNUAL AND GROWING SEASON TEMPERATURES, 1900–2012



Source: University of East Anglia, Climatic Research Unit, Norwich, UK.

sensitive to climate change and therefore vulnerable to future extremes: the Black Sea coast, the Lower Svaneti (Lentekhi district), and the Dedoplistskaro district of the Alazani river basin.

The effect of climate change on temperature increases will be greater at higher altitudes. This is likely to increase the pressure on biodiversity in the Caucasus Mountains—a world hotspot of biodiversity with a high percentage (25 percent) of endemic species. Urbanization and rapid population growth carry disproportionate socioeconomic impacts and increase the vulnerable population and expected losses. This impact is demonstrated by the flood in the Kakheti Region in 2012, in which 75,000 people were affected and there were economic losses equivalent to GEL 202 million. Both public and private assets will increasingly become vulnerable to climatic-related hazards. The consequences of climate change may dramatically increase the frequency and risks of medium-size and high-impact disasters in Georgia. The Social and Economic Vulnerability analysis carried out by the Caucasus Environmental NGO Network (CENN) used a Spatial Multicriteria Evaluation method and estimated the vulnerability of population and physical assets as "high" to "significant" for landslides, mudflows, and rock fall.

Disaster risk forecasting, monitoring, and early warning capacities are limited in Georgia. Currently, the hydro-meteorological system is heavily reliant on ground stations, which have dramatically declined in number since the 1990s. Moreover, no upper-air measurements are conducted, hampering the monitoring and prediction of intense localized weather-related hazards.

AIR QUALITY MANAGEMENT

One of the many consequences of the increased economic activity that accompanies urbanization—particularly increased vehicle use and industrial production—is deterioration of air quality (Molina and Molina 2004). According to WHO, only 15 percent of the largest cities in developing countries have acceptable air quality and Georgia, albeit a small country, is in line with this trend.

Ambient air quality, including total suspended particulates, is currently monitored in only five towns: Tbilisi, Kutaisi, Zestafoni, Rustavi, and Batumi. Measurements of NO_2 and CO concentrations are provided for Rustavi. Only Tbilisi has an automated monitoring station that monitors $PM_{2.5}$ and PM_{10}. Next to main roads the measured concentrations of dust, CO, SO_2, NO_x are higher than the maximum allowable concentrations. Volatile organic compounds, heavy metals (except MnO_2 and lead), and persistent organic pollutants are not regularly measured in Georgia (see box 2.1).

Air pollution is a serious issue for all urban centers but especially for Tbilisi, Rustavi, and Kutaisi. The main sources of pollution are traffic followed by industrial sources (metallurgical, chemical, and construction). Many industries were abandoned or operate without proper environmental oversight. Without regulatory supervision, control, and monitoring, enterprises maintain unsafe quantities of industrial waste, which increases public health risks and social cost.

Like most countries, Georgia banned leaded fuel in 2000. In 2012, a maximum allowable concentration of lead was lowered from 0.0 13 g/L to 0.005 g/L. Georgia has introduced a maximum allowable concentration level for sulfur of 50 mg/kg for gasoline and diesel since 2015. (See table 2.1.)

Leaded gasoline is one of the sources of atmospheric lead. It is highly toxic, and no level is considered safe. Lead in the human body is distributed in the brain,

BOX 2.1. AIR QUALITY MONITORING IN TBILISI

The Air Quality Governance project under the European Neighborhood and Partnership Instrument (ENPI) East Countries is helping Georgia to prepare a national project for improvement of the national air quality monitoring system. Georgia will develop an air quality monitoring network and set relevant guidelines in compliance with European Union standards. The preliminary project results indicate that pollutants regulated by the Clean Air for Europe Directive[1] on ambient air quality (NO_x, CO, SO_2, PM_{10}, $PM_{2.5}$, and ozone [O_3]) exceed the Lower Assessment Thresholds, Upper Assessment Thresholds, and Limit Value much throughout Georgia. The results for Tbilisi best represent the most sensitive air quality issues. The study used data from the National Network monitoring measurement data 2008–13 (see table 2.2), the National Emission Inventory Data for Georgia 2012, area and mobile sources of air pollutants, and short-term diffusion tube data to carry out emissions dispersion and air quality modeling of point sources.

The results of the analysis using the ADMS-Urban modeling tool showed higher than the EU NO_x average limit value of 40 micrograms per cubic meter ($\mu g/m^3$) across the majority of the central area of Tbilisi. Likewise, PM_{10} concentrations exceeded the average limit value of 40 $\mu g/m^3$ along the major roads and SO_2 concentrations exceeded the 24-hour mean Georgian maximum allowed concentration (MAC) of 50 $\mu g/m^3$ along major roads. The majority of stationary air emissions were identified as emanating from a small number of industries. The aggregated emissions resulting from domestic heating systems provided a significant contribution to the ambient air concentrations of NO_2. Road transport is responsible for over 90% of the emissions to air of NO_x, NO_2, VOC, and CO within the city. In addition, road transport is responsible for 67% of all PM_{10} emissions to air and 83% of all SO_2 emissions. A large proportion of the emissions from road transport originated from the use of private vehicles rather than minibuses, buses, or heavy-goods vehicles. Emissions from domestic heating occur largely in northeast Tbilisi, where the population density is at its maximum. Annual average NO_2 limit values are routinely exceeded within the city, whereas NO_x emissions from domestic heating are at a maximum in northeast Tbilisi.

[1] Directive 2008/50/EC of the European Parliament and of the Council of May 21, 2008, on ambient air quality and cleaner air for Europe in effect since June 11, 2008.

TABLE 2.1. GEORGIA NATIONAL REQUIREMENTS FOR GASOLINE QUALITY

<table>
<tr><th colspan="2">Lead Content (g/L)</th><th rowspan="2">Benzene % (v/v)</th><th rowspan="2">Aromatic Hydrocarbons % (v/v)</th><th colspan="2">Sulfur Content (mg/kg)</th><th rowspan="2">Comments</th></tr>
<tr><th>Leaded</th><th>Unleaded</th><th>Normal</th><th>Regular</th></tr>
<tr><td>N/A</td><td>0.013</td><td>5</td><td></td><td colspan="2">500</td><td>Until Jan 1, 2012</td></tr>
<tr><td>N/A</td><td>0.005</td><td>3</td><td>42</td><td colspan="2">250</td><td>From Jan 1, 2012, to Jan 1, 2014</td></tr>
<tr><td>N/A</td><td>0.005</td><td></td><td>42</td><td colspan="2"></td><td>From Jan 1, 2014, to Jan 1, 2015</td></tr>
<tr><td>N/A</td><td>0.005</td><td>3</td><td>42</td><td colspan="2">50</td><td>From Jan 2015 to Jan 2017</td></tr>
<tr><td>N/A</td><td>0.005</td><td>3</td><td>42</td><td colspan="2">100</td><td>From Jan 2017</td></tr>
</table>

Source: Regional Environmental Center for the Caucasus, www.rec-caucasus.org;
Order 124 of the Government of Georgia on quality norms of petrol from December 31, 2004.
Note: g/L = grams per liter; v/v = volume to volume.

liver, kidney, and bones and is stored in blood, teeth, and bones, where it accumulates over time. Human exposure can be assessed directly through measurement of lead in blood, teeth, or bones. Lead has serious health impacts—it impairs development of brain function and lowers intelligence quotient (IQ), and children are affected four to five times more than are adults (UNEP 2012). Georgia imports roughly 450,000 tons of gasoline per year. A significant part of the car fleet in use is old, with 27 percent of vehicles aged between 16 and 20 years and 30 percent older than that. Georgia's legislation regulating vehicles is restricted only to the elaboration of road safety rules.

A central problem is the lack of regulation of vehicle emissions, lack of continuous monitoring of imported fuel, and fuel at retail. Also, the government has not

TABLE 2.2. AIR QUALITY MONITORING RESULTS FOR TBILISI STATIONS AS ANNUAL AVERAGES, 2008–13

Pollutant	Location	2008	2009	2010	2011	2012	2013
		Concentration μg/m³					
dust	Kvinitadze St.	780	500	430	500	500	693
PM_{10} (assuming a ratio of 1.35 dust to PM_{10})	Kvinitadze St	578	370	319	370	370	513
SO_2	Kvinitadze St	130	120	98	90	90	119
CO	Kvinitadze St	5,100	4,000	3,600	2,800	2,970	3,333
	Moscow Ave.	—	—	—	—	2,600	2,557
	Tzereteli Ave	—	—	—	—	4,200	4,884
NO_2	Kvinitadze St	60	70	92	88	89	100
	Moscow Ave.					87	87
O_3	Kvinitadze St	—	—	13.6	34	13	26
Lead (μg/m³)	Kvinitadze St	0.33	0.22	0.2	0.21	0.13	0.1

Source: CENN 2014.

reinstated mandatory vehicle inspections and emission control. Traces of lead pollution are still found in the soil. Based on interviews with experts, one plausible hypothesis appears that in order to prevent knocking and lubricate engine valves, organic lead additives such as tetraethyl lead (PbEt4), tetra methyl, and mixed lead alkyls are routinely mixed with gasoline to enhance octane. Although results of occasional tests of gasoline quality at gas stations did not register lead above allowable limits, without effective monitoring and control of gasoline quality certain concerns remain.

WASTE MANAGEMENT

Total waste generated in Georgia on a daily basis is 8,186.3 m³ (Georgian Greens/Friends of Earth Georgia et al. 2012). There are 63 registered landfills, which occupy more than 300 ha of which 203 ha are active landfills (MENRP 2012). The largest landfill area is in Imereti (100 ha), followed by Tbilisi (80 ha), Kakheti (58 ha), Samegrelo (41 ha), Kvemo Kartli (28 ha), Adjaria (19 hectares), Shida Kartli (18 ha), and Samtskhe-Djavakheti (11 ha). The solid waste sector employs 5,261 people. Many illegal dumpsites are located near populated areas, motorways, natural water reservoirs, riverbeds, and ravines.

Most of the 63 landfill sites functioning under local government authorities operate without proper measures for groundwater protection, leachate collection, or treatment. In addition, in 28 unplanned landfills in villages there are no waste management services. At present there are no sanitary landfills with segregation of waste for energy production. The recycling facilities are scarce and limited, whereas composting is observed by some farmers.

A new Waste Code (2014) has been the approved. It sets clear institutional responsibilities for planning, facilities ownership, operation, and so on. Nonetheless, implementation remains a major challenge. The state-owned company Solid Waste Management Ltd, established under the Ministry of Regional Development and Infrastructure, is responsible for actions in respect to construction, operation, and closure of municipal waste landfills in the country, excluding the capital city of Tbilisi and Adjara Autonomous Republic. These positive steps need to be followed by a major capacity building effort.

There are almost no statistical data on industrial waste. This is because of the lack of a system for registering, collecting, treating, and disposing of hazardous waste. There are no special legal provisions or general rules for management of industrial waste. It is regulated through environmental impact permits. However, the permit system needs strengthening. Enforcing the permit system has been especially problematic. In addition, there are no regulations for activities not requiring permits. Waste and sludge from mining and enrichment industries located close to urban settlements (for example, in Tsana close to the town of Lentekhi and in Uravi close to the town of Ambrolauri), including former arsenic extraction and enrichment facilities, is a major public health hazard. In 2003–07 with the assistance of GEF/UNDP, the government developed a National Implementation Plan for the implementation of the Stockholm Convention on Persistent Organic Pollutants. It included the elimination of 2,700 tons of obsolete pesticides from the storage area of the Lagluja Hill dumpsite as a top priority. A thorough assessment and remediation plan have been carried out, but without a financial support for implementation the risks of Lagluja hot spot deteriorating environmental quality and health effects on poor and vulnerable populations would remain a serious concern.

Georgia's tourism's potential could be affected by the quality of the environment and severely restricted by poor air and water quality and collapsing coastal ecosystems because of pollution. Conversely, the tourism industry, if not properly planned and managed, may exert extra pressures on ecosystems. This could be a result of construction in sensitive ecosystems, lack of treatment infrastructure, and pollution from emissions from tourism-related transportation contributing to deteriorating air quality and so on. To address these potential risks, the government needs to put in place environmental policies and legislative provisions to meet the national economic development goals. Tourism as an economic driver for Georgia has great growth potential. The National Statistics Office reports that the total output of tourism-related services—including hotel services, camping sites and other short-stay accommodations, restaurant services and transportation, and travel agency and tour operator services—increased by 73.5 percent in 2011 over the output in 2006 and amounted to 7.1 percent of the country's total economic output.

CHANGING GLOBAL LANDSCAPE

Georgia has been a signatory of the UN Millennium Declaration since September 8, 2000, along with 146 other nations, and the government agreed to adopt measures aimed at improving the situation on poverty, education quality, sustainable environmental development, maternal health and child care, gender equality, and human immunodeficiency virus (HIV)/AIDS reduction by 2015. The Human Development Index is associated with the Millennium Development Goals and is used to assess progress toward social and economic development. The MDGs include eight goals with 18 targets and 48 indicators on sustainable development. Despite a strong increase in GDP per capita and monthly salaries, it is unlikely that Georgia will meet its target of reducing the proportion of people living under the extreme poverty line to 4 percent.

Morbidity per 100,000 population from respiratory illnesses has been on the rise (National Center for Disease Control, Georgia 2009). This includes illnesses such as chronic obstructive pulmonary disease, pleurisy, pneumonia, and lung cancer. Child mortality, albeit declining by nearly 14 percent to 26.5 per thousand in 2008, remains a concern. The same source points to diseases such as respiratory illnesses as the most significant causes of mortality. In light of these observations, certain inferences can be drawn between environmental degradation and human health. These concerns point to the need to expand the policy debate on environmental factors and public health.

The government's document *Basic Data and Directions in 2009–2012* draws up a concrete list of priority actions to meet the environmental sustainability development goals (Goal No. 7; see table 2.3). Despite many positive developments, Georgia was unlikely to fully meet this goal by the 2015 deadline (Organization for Economic Co-operation and Development [OECD] 2011).

Sustainable development is a priority reflected in the National Indicative Program as a milestone of the deepening integration with the European Union (EU 2009). However, in order to meet its sustainability goal, Georgia needs to consider important social and environmental aspects. In the economic arena, indicators such as GDP and rates of inflation are used to gauge the vitality of the economy and to guide policy. Although many indicators in use around the world aim to influence environmental policy and management, a few could help policy makers measure progress. For instance, the Yale/Columbia Environmental Sustainability Index and its successor, the Environmental Performance Index (EPI) cover a wide range of environmental parameters, help identify policy priorities,

TABLE 2.3. MDG 7: ENSURE ENVIRONMENTAL SUSTAINABILITY—PROGRESS 1990–2012

Comp: align turnover lines in tables rather than hanging them

Goals and Targets	Indicators	First Year Value	First Year Year	Latest Year Value	Latest Year Year	Change %	Country Progress Level of Compliance
Reverse loss of forests	Proportion of land area covered by forest (%)	40	1990	39.5	2010	−1	Medium forest cover
Halve proportion without improved drinking water	Proportion of population using and improved drinking water source (%)	85.0	1990	98.7	2012	16	High coverage
Halve proportion without sanitation	Proportion of population using an improved sanitation facility (%)	96.5	1990	93.3	2012	−3	High coverage

Source: http://mdgs.un.org/unsd/mdg/Resources/Static/Products/Progress2012/technicalnote.pdf.

and frame ways of measuring progress toward their attainment.[4] The EPI frames issues in terms of discrete sets of identifiable and actionable performance targets and draws attention to the merit of quantitative, outcome-oriented environmental policy (Emerson et al. 2012). The Ecological Footprint, in comparison, frames environmental problems as a function of overconsumption of resources (Wackernagel et al. 2004). EPI indicates how well countries rank on high-priority issues in two broad policy areas. Based on data collected through the Yale/Columbia 2010, EPI ranks Georgia 101 among 178 countries.[5]

The UN Rio+20 Summit in Brazil in 2012 committed governments to create a set of sustainable development goals (SDGs) as a follow-up to the MDGs after 2015. The biggest challenge for many developing countries post-2015 will be to meet the SDGs that aim at addressing the root causes of poverty and environmental degradation while trying to achieve the paradigm shift crucial to build sustainable societies. The SDGs reframe MDGs and the three pillars of sustainable development—economic, social, and environmental—along the "must haves" for human prosperity, drawing from science and existing international agreements.

The SDG targets are extended for 2030 and include thriving lives and livelihoods, sustainable food security, sustainable water security, universal clean energy, healthy and productive ecosystems, and governance for sustainable societies. The driving principles are reducing poverty and hunger, improving health and well-being, and creating sustainable production and consumption patterns. The first step for Georgian policy makers for achieving sustained economic growth is to embrace the paradigm of unified economic, environmental, and social development and to minimize environmental degradation and human health risks. The next step will be to track progress on these goals by benchmarking them to internationally accepted indicators of sustainable development and to assess national policy in a complex manner, considering fundamental economic welfare and intergenerational aspects. Such an approach would set Georgia on the path to sustainable development.

Several significant environmental issues are at the top of the government's agenda—issues that are complex in nature and loaded with social and economic implications. Improving **urban air quality** is one of the key challenges. It is well established that the age and quality of the automobile fleet as well as the quality of fuel have significant implications for air quality. However, imposing technical control over vehicles being imported and/or

[4] The EPI is constructed through the calculation and aggregation of 20 indicators reflecting national-level environmental data. The indicators are combined into nine issue categories, each of which is under one of the two overarching objectives: protection of human health from environmental harm and protection of ecosystems. These are categories that span high-priority environmental policy issues, including air quality, forests, fisheries, and climate and energy, among others. For Georgia's ranking, see epi.yale.edu/epi/country-profile/georgia.

[5] EPI indicators use a "proximity-to-target" methodology, which assesses how close a particular country is to an identified policy target. Scores are then converted to a scale of 0 to 100 by simple arithmetic calculation, with 0 being the farthest from the target (worst observed value) and 100 being closest to the target (best observed value).

operated in the country continues to be delayed as the livelihoods of many poor people depends on cars that do not meet impending requirements. Tighter control on the fuel quality and/or increasing quality requirements is likely to be reflected in the price of fuel, which is also a sensitive issue.

Building **infrastructure for solid waste disposal** is under way despite high investment costs because of its absolute urgency. Achieving a major breakthrough in this field will require much more effort, though, because operationalization of a decent waste management system in the country should also include elements of waste minimization, separation, and recycling, as well as financially viable arrangements for waste collection and transportation. Long-term solutions for handling and final disposal of hazardous waste are yet to be worked out.

Sustainable **management of forest resources** has been a tough challenge and a battlefield in the fight against corruption over several decades. The institutional and legal framework for the forest sector is being developed. Discontinuing deforestation and forest degradation in parallel with meeting ever-high demands of the poor for fuel wood is a key challenge, one amplified by the need to find sustainable scenarios for the commercial production of timber and controlling transformation of land under forests.

The impacts of global climate change are becoming increasingly visible in Georgia in the form of an increase in extreme weather occurrences. This results in devastating natural disasters, often times aggravated by anthropogenic factors. **Disaster risk reduction** is among the key challenges faced by the government, because of the high economic and social costs of disasters' aftermath. Along this path, a variety of issues related to forecasts and early warning, monitoring and recording, and public awareness and insurance will have to be handled.

CHAPTER THREE

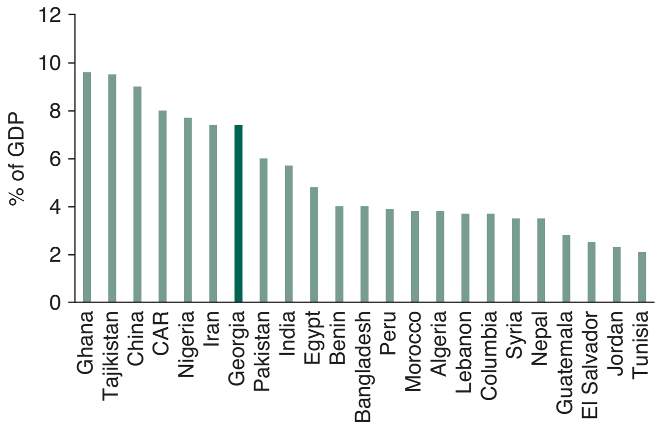
VALUATION OF ENVIRONMENTAL DEGRADATION—CHALLENGES AND OPPORTUNITIES TO CHANGE THE COURSE

INTRODUCTION

This chapter estimates the costs of environmental degradation from anthropogenic sources, focusing on the health effects of ambient air pollution, household air pollution, lead exposure, problems of agricultural land degradation, deforestation, solid waste risks, and loss of amenity from solid waste disposal sites and natural disasters. The estimation is based on a combination of the latest available data and information from government officials and experts in the country. Damages are estimated in monetary terms and are given as annual costs for activities in various sectors of the economy. As much as possible these costs refer to 2012, the latest year for which much of the environmental data were available. This list is not complete as far as potential damages are concerned. Only quantifiable environmental costs are covered in this report. The estimates given here are also tentative.

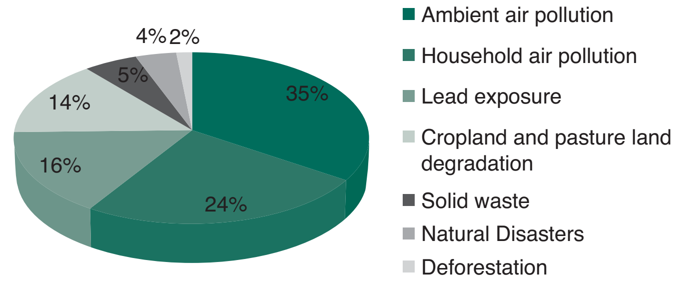
The approach used in calculating the costs of environmental degradation is based on estimating damages directly and valuing them in money terms. These include damages to health and well-being using established statistical relationships between levels of pollution and certain health "end effects," such as premature mortality and morbidity. The health end effects are then converted into money terms using established valuation techniques that take account of economic costs of illness as well as individuals' willingness to pay these costs to avoid the negative health effects. A similar approach of valuing damages is applied in calculating the economic losses because of environmental degradation from agricultural land degradation, disposal of solid waste, deforestation, and natural disasters. In each case, the services provided by the natural environment are reduced on account of damage or overuse, and the loss of these services is valued. (More details are provided in Croitoru and Sarraf 2012.)

FIGURE 3.1. COST OF ENVIRONMENTAL DEGRADATION (HEALTH AND NATURAL RESOURCES DAMAGES)



Source: Author's estimate; World Bank 2012.

FIGURE 3.2. SHARE OF COSTS OF DEGRADATION BY SECTOR



Source: Estimated by authors.

Comp: align turnover lines in tables rather than hanging them

Subject to all these limitations, the annual COED in Georgia is estimated at about GEL 2 billion or 7.4 percent of the country's 2012 GDP. The range obtained is between 5.5 percent and 12.7 percent, although this is not a full reflection of the uncertainty in the estimates, which is considerably greater. In comparison with other countries where the World Bank has conducted similar studies, the figures are in the higher range in percentage terms, although COED valuation methodology has been changing over the years of the studies.

Earlier work in the Middle East and North Africa regions with similar climate conditions and income per capita yielded estimates of between 2 percent and 7 percent (covering Algeria, Egypt, Iran, Jordan, Syria, Lebanon, Morocco, and Tunisia). (See figure 3.1.) There are some possible reasons for the higher figures for Georgia. First, high ambient air pollution estimates are very uncertain and should be updated to reflect continuous ambient air quality monitoring in cities. Second, some possible categories of damages are not covered in other studies.

Damages by sector for Georgia are shown in figure 3.2 and table 3.1. The largest share of damages is caused by ambient air pollution (35 percent), followed by household air pollution (24 percent), lead exposure (16 percent), and agricultural land degradation (14 percent).

TABLE 3.1. SUMMARY OF ANNUAL COSTS OF ENVIRONMENTAL DEGRADATION IN GEORGIA

	Midvalue	Low	High
Impact in US$ Million			
Ambient air pollution	**402**	282	820
Household air pollution	**282**	198	576
Lead exposure	**183**	147	218
Cropland and pasture land degradation	**168**	148	187
Solid waste	**61**	57	64
Natural disasters	**45**	24	117
Deforestation	**23**	17	29
Total	**1,164**	873	2,010
As % of 2012 GDP	**7.4%**	5.5%	12.7%
Impact in GEL million			
Ambient air pollution	**684**	479	1,393
Household air pollution	**480**	336	978
Lead exposure	**310**	250	371
Cropland and pasture land degradation	**286**	252	318
Solid waste	**103**	97	109
Natural disasters	**77**	41	199
Deforestation	**39**	29	49
Total	**1,978**	1,484	3,417
As % of 2012 GDP	**7.4%**	5.5%	12.7%

Source: Calculations by authors (COED).

Other sector shares are solid waste (5 percent), natural disasters (4 percent), and deforestation (2 percent). The greatest uncertainties relate to potential damages from air pollution and solid waste.

Despite these limitations, the figures indicate the areas where environmental costs are incurred and the approximate terms of the costs of past and present misuse of resources in the Republic of Georgia. They can be the basis of discussion of policies to reduce damages in the future and for actions that put less pressure on the country's natural resources.

AGRICULTURE AND LAND RESOURCES

Agriculture remains an important sector in Georgia, providing employment of over 50 percent of the population and contributing to about 25 percent of exports. The share of agriculture in GDP has significantly declined (from 25 percent in 1999 to about 8 percent in 2012) (World Bank 2014). According to the agricultural census in 2005, most of the agricultural holdings in Georgia were family farms, dominated by small private farms (93 percent with less than 2 hectares of land). About 82 percent of agricultural farms are subsistence and 18 percent are semi-subsistence (EU Partnership Program 2012).

Nearly 47 percent of the Georgian population lives in rural areas (National Statistics Office of Georgia 2012). Agricultural land, including arable land, perennial crops, hay fields and pastures, occupies approximately 3 million hectares or about 43.5 percent of the country's territory (National Statistics Office of Georgia 2012). Approximately 30 percent of the cultivated land is sown for perennial crops such as fruits (grapes, apples, pears, cherries, peaches/apricots, berries, and citrus fruit), nuts (walnuts and hazelnuts), tea, and vegetables. The other 70 percent is covered by annual crops such as grains (wheat, maize, barley, and sunflower), grapes, legumes, potatoes, sugar beet, and tobacco (Ahouissoussi et al. 2012).

Georgia's agriculture is mainly of a subsistence nature: more than 90 percent of the agricultural production is concentrated within highly fragmented small-scale family holdings. On average, the size of a family holding is 1.22 ha, fragmented into two or three land parcels of 0.45 ha on average. About 82 percent of family holdings produce mainly for self-consumption, whereas the remaining 18 percent produce cash crops (Kvaratskhelia and Shavgulidze 2011). Additionally, livestock is an important subsector of the agriculture. Cattle, sheep, pigs, and goats are the major livestock. Even though the cash income of the households engaged in agriculture is low, the sector provides an important safety net for most of the rural population, and its performance is crucial to poverty reduction (Kvaratskhelia and Shavgulidze 2011).

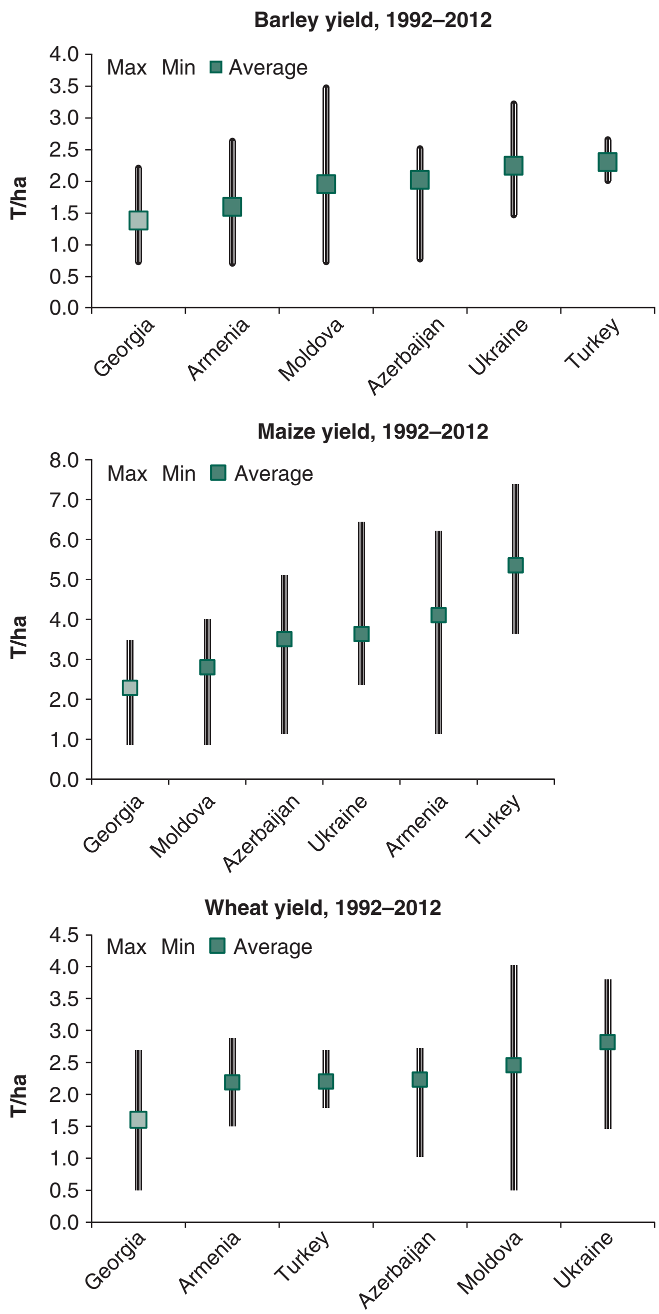
Between 2006 and 2010, critical public services and infrastructure for agriculture, including irrigation, advisory, and veterinary services, collapsed. This, in combination with a ban on sales of Georgian wine and mineral waters in Russia and exchange rate appreciation, resulted in a collapse of agricultural production in 2006. During the last 25 years the irrigated area has declined from 386,000 ha in 1988 (291,000 ha gravity-fed and 95,000 ha pumped irrigation) to 105,600 ha in 2004. The Ministry of Agriculture reports that only 25,000 ha are now irrigated. The drained area has declined from 114,300 ha in 1988 (84,300 ha gravity-fed, 30,000 ha pumped irrigation) to 5,584 ha in 2012 (World Bank 2014a).

The collapse of irrigation and contraction of markets resulted in a drastic yield decline in Georgia. The average yield of barley, maize, and wheat in 1992–2012 was lowest in Georgia compared with other countries with similar agricultural practices (Armenia, Azerbaijan, Moldova, Ukraine, and Turkey). (See figure 3.3.)

Agricultural decline is accompanied by a significant share of unused agricultural lands in Georgia. It is apparent from available Food and Agriculture Organization (FAO) statistics and from Georgia statistical reports that a significant amount of the arable land is unsown/unused (130,000 ha, mainly in the eastern part of the country). As the EU Partnership Program (2012) reports, many of the title owners of these lands have moved away from the area, just abandoning their land because land has no cost and no land taxes are payable on holdings less than 5 ha. Thus, as in the EU Partnership Program (2012), there are a lot of fragmented land holdings (which cannot be used for collateral), where 80 percent of the plots are hand-cultivated with a minimal use of inputs. This is one of the main reasons for agricultural decline.

At the same time, land degradation is widespread in Georgia. As the Ministry of Environment Protection (MOEP) and Natural Resources of Georgia reported, about 35 percent of the agricultural lands in Georgia are

FIGURE 3.3. MAJOR CROPS' MAXIMUM, MINIMUM, AND AVERAGE YIELD IN SELECTED COUNTRIES, 1992–2012



Source: Authors' estimates based on FAO 2014.

degraded (MENRP 2006). Land erosion is a major problem, with more than 1 million hectares of land eroded, including 380,000 ha of cropland. (See table 3.2.) In eastern Georgia, about 105,000 ha of cropland are affected by wind erosion. About 54,000 ha are saline and 15,000 ha are acidified. Land desertification is another form of environmental degradation as a result of progressive loss of

TABLE 3.2. ESTIMATION OF ERODED AND DEGRADED CROPLAND IN GEORGIA

	Thousand Hectares
Total agricultural land	840
Wind erosion	380
Water erosion	105
Saline lands	54
Acidified lands	15

Source: MENRP 2006.

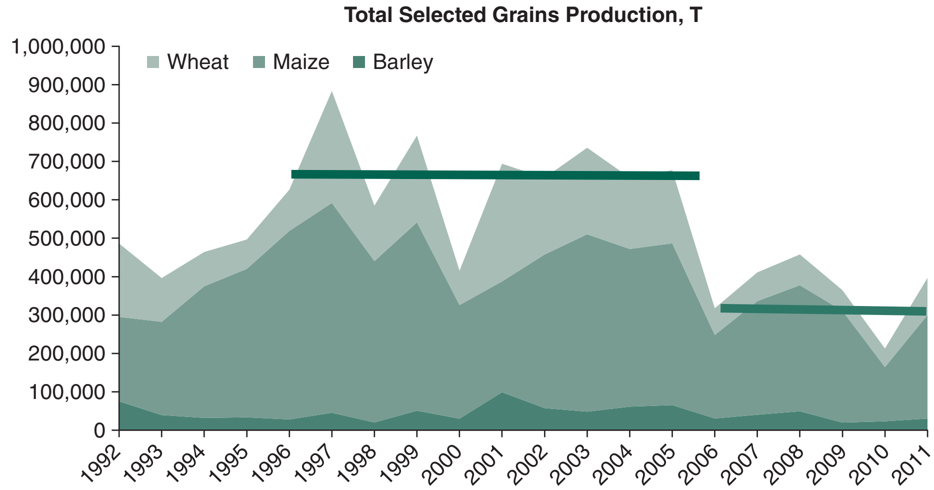
vegetation cover in dry steppes and semi-deserts. Uncontrolled felling of floodplain forests used as fuelwood, overgrazing, destruction of wild shelter belts, and so on are among the key causes for land desertification. About 4 percent (3000 sq km) of the country is vulnerable to desertification. The areas prone to desertification are in the Shiraqi, Eldari, Iori, Taribani, Naomari, Ole, and Jeiran-Choli valleys.

Georgia has a history of floods and erosion through landslides and mudflow, and climate change is likely to increase the frequency and magnitude of flooding in the region, leading to further damages. From 1995 to 2012, floods and erosion particularly affected by landslides and mudflow led to US$650 million in economic losses (Ahouissoussi, Neumann, and Srivastava 2014). Although the extent of future warming in Georgia is uncertain, the overall warming trend is clear. Predicted temperature increases for Georgia are highest in September, and precipitation decreases are greatest in July and August (relative to current conditions). The September temperature increase is estimated to be as much as 5°C in the eastern lowlands agricultural region, when temperatures are already near their highest.

Furthermore, forecasted precipitation declines are greatest in the key May–October period, making the late summer and early fall the driest times of year. Disastrous weather events, including floods, landslides, and mud torrents, are becoming more common in this area. Increased frequency and intensity of these phenomena cause land erosion that affects agriculture, forestry, road transport, and communications.

In total, about 66 percent of agricultural lands are eroded or degraded. These lands may be abandoned or their productivity significantly reduced. Figure 3.4 presents

FIGURE 3.4. ANNUAL AVERAGE CROP PRODUCTION LOSS IN GEORGIA, 1992–2011



Source: FAO 2014; estimates by authors.

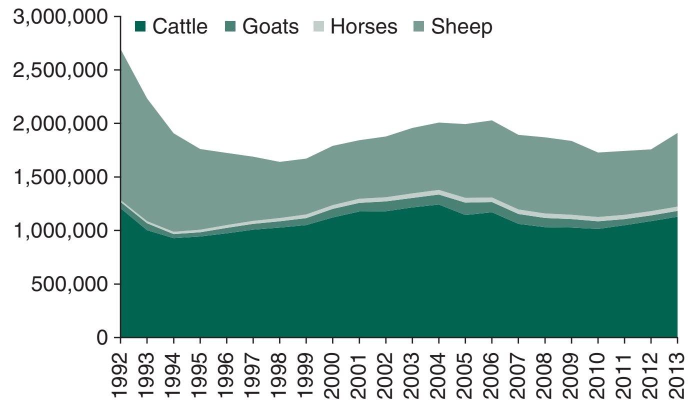
crop production reductions since 1992 that are attributed to both economic and environmental reasons.

The resulting annual loss of crop production in Georgia is estimated at about US$87 million.[6] About 20–65 percent is associated with losses owing to agricultural land degradation. Then total annual crop production losses are at US$17–US$56 million, with a midpoint at US$37 million.

Pastures in Georgia have been under an increasing overgrazing pressure. The total amount of livestock in Georgia has not been reduced since 1994 (FAO 2014). (See figure 3.5.) At the same time, milk and especially meat production reduced dramatically (EU Partnership Program 2012), suggesting that unproductive cattle breeds sustained by traditional free-ranging feeding practices and by poorly managed state and communal grasslands has resulted in overgrazed pastures. (See figure 3.6.)

The productivity of the overgrazed nearby lands does not provide the nutrition required for fattening animals or higher milk yield. The annual cost of pasture overgrazing is estimated in local producer cattle and sheep meat prices at about US$131 million. Total estimated annual cost from cropland and pastures degradation is presented in table 3.3.

FIGURE 3.5. LIVESTOCK IN GEORGIA



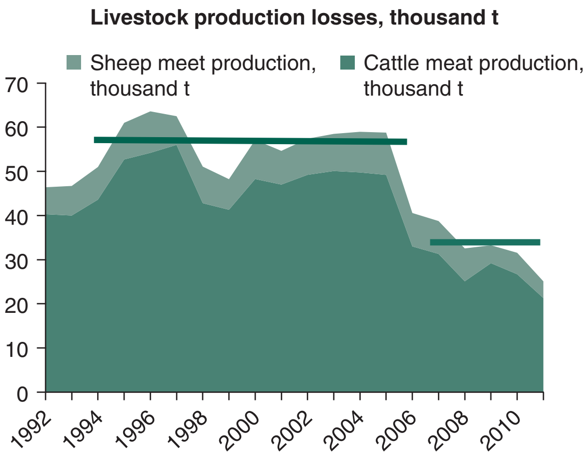
Source: FAO 2014.

FORESTS

Georgia's forests are a vitally important environmental and economic resource. Forests cover 2.8 million hectares, 40 percent of the country's territory. They provide a valuable habitat for biodiversity and play an important ecosystem regulation function (soil erosion prevention, water recharge, natural disasters mitigation, climate stabilization, and so on). Georgia's forests are important regionally. Within the Caucasus Eco-Region—one of

[6] Production losses are estimated at the import prices, as Georgia imports a substantial amount of grain (FAO 2014).

FIGURE 3.6. ANNUAL AVERAGE MEAT PRODUCTION LOSS IN GEORGIA



Source: Estimated by authors from FAO 2014.
Note: t = tons.

TABLE 3.3. ANNUAL COST OF CROPLAND AND PASTURE DEGRADATION IN GEORGIA (US$)

	Low	Midpoint	High
Cost of cropland degradation	17	37	56
Cost of pastures overgrazing	131	131	131
Total	148	168	187
% GDP	0.9%	1.1%	1.2%

Source: Authors' estimates.

the Global 200 eco-regions—Georgian forests are critical for the conservation of global biodiversity. A vast majority of forested land—98 percent—is represented by mountainous forests that provide an important habitat for many relict, endemic, and endangered species of plants and animals. Almost intact forest stands, which have the greatest conservation value, have been preserved in Georgia. Protected areas in Georgia are 7.5 percent of Georgia's territory (2014). It is estimated that forest vegetation in selected ecosystems contribute significantly to carbon sequestration. The estimated annual carbon dioxide ($CO_{2)}$ absorption in the Georgian forest equals 8 tCO_2/ha, or 50,976 tons of CO_2.

Deforestation is not confirmed by Georgian official statistics. However, it is believed that it is a serious problem. An annual loss of tree cover is reported by Global Forest Watch. The report on the MDG indicator for 2010 shows that the percentage of land area covered by forest is 0.5 percent lower than the 40 percent in 1990. A major driving force of deforestation is the use of solid fuel for cooking and heating in households. Deforestation is an important trigger of soil erosion. It appears at a substantial level. A significant part of the land is affected by water and wind erosion and is estimated at 15.5 percent of the total land.

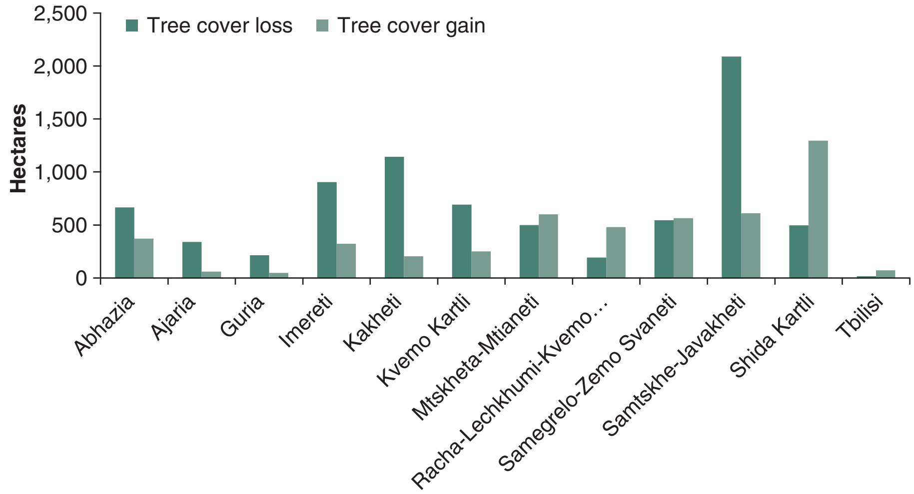
Unsustainable management of forests is exacerbated by illegal logging. Although in recent years the volumes of illegal logging have dropped significantly, they still remain at unacceptable levels. Officially, the total volume of illegal logging was reduced to as little as 7,339 m^3 in 2011. The actual scale of logging substantially exceeds the rate of natural growth of forests located near human settlements (Matcharashvili 2012; NBSAP-2). As a result, these forests are severely degraded—the canopy cover has reached critically low thresholds (less than 50 percent) in more than 55 percent of forest area (NBSAP-1 2005). Satellite images of the project from the University of Maryland, Google Tree Cover Loss, measure forest change data, tree cover loss, tree cover gain, and forest disturbance.[7] They show increasing forest degradation in certain areas in Georgia through the period of 2001–13. However, providing that there is no large-scale, clear-cut logging, but instead mostly selective logging in Georgia, not all present degradation could be detected at the given resolution (30 m).[8]

Infrastructure development is a relatively new threat to forests and biodiversity. Rapid economic recovery and growth are likely to trigger large-scale infrastructure development in Georgia in the coming years (NBSAP-2). This includes new pipelines, dams, power lines, railways, mining facilities, roads, and buildings. Figure 3.7 presents the approximate dynamics of forested land reduction in Georgia in 2001–12, as forestland is defined in the Global Forest Resources Assessment (FAO 2010). Accordingly, forest area gain is also estimated based on this method (www.globalforestwatch.org). Tree cover loss in 2007–08 for the Samtskhe-Javakheti region was excluded because this loss is associated with other than usual economic activity.

[7] http://www.globalforestwatch.org/sources/forest_cover.

[8] University of Maryland, Global Forest Cover Change: http://forstcover.org.

FIGURE 3.7. FOREST COVER AREA DYNAMICS IN GEORGIA, 2001–12 (HECTARES)



Source: Global Forest Watch, www.globalforestwatch.org.

Over the past 12 years, it is estimated that forest cover in Georgia has been reduced by 7,800 ha and has gained 4,900 ha of a different quality. (See figure 3.8.) It is assumed that lost tree cover is associated with 80 percent forest ecosystem value loss, and gained hectares are associated with 50 percent forest value gain.

Several meta-analysis studies of ecosystem services values are available (Groot, Fisher, and Christie 2012; Hussain et al. 2011). The Groot study is a background study done for The Economics of Ecosystems and Biodiversity project. It presents a meta-analysis of different ecosystem services valuation studies all over the world. It gives a good

FIGURE 3.8. FOREST DISTRIBUTION

Source: Georgian Ministry of Environment, Department of Forest 2010.

TABLE 3.4. ESTIMATED ANNUAL DEFORESTATION COST IN GEORGIA (US$, MILLIONS)

	Low	Midpoint	High
Annual loss	17	23	29
% GDP	0.11%	0.15%	0.18%

Source: Estimates of authors.

summary of reported values of ecosystem services in different ecosystems, including tropical forests and boreal/temperate forests. Based on unit monetary values of ecosystem services, we applied conservative median values from the study for two different categories of ecosystems: tropical forests estimated at about US$2,100/ha/year and temperate forests at US$1,100/ha/year, climate service excluded. The annual forest value in Georgia is thus estimated in a range from US$2,100 to US$1,100/ha/year without climate service.

The total amount of carbon accumulated in 1 ha of forest in Georgia is estimated at 88 tons per hectar (t/ha) for wet forests and 38 t/ha for dry forests (FAO 2010). Carbon's value is based on its social cost calculated at a 5 percent discount rate (US$12 per ton of CO_2), which represents a conservative estimate of social cost but is above the current commercial value of carbon offsets (Golub 2014). The one-time cost of lost climate regulation services is a product of the social cost of carbon, the annual average ecosystem area loss, and the carbon sequestered and stored by 1 ha of lost ecosystem. Note that all calculations are performed in CO_2 equivalents.

The annual value of ecosystem service losses is estimated as the net present value (NPV) of flow of net benefits from lost ecosystem area and the one-time cost of carbon lost in deforested areas. This flow of net benefits is a product of a value of ecosystem services and annual average ecosystem area loss over the period 2001–12. In order to capitalize the flow of ecosystem services, the lost value (excluding climate services) NPV is calculated applying a 3 percent discount rate.

Thus, the total cost of annual deforestation in Georgia is estimated at US$23 million (0.15 percent of GDP in 2012; see table 3.4).

NATURAL DISASTERS

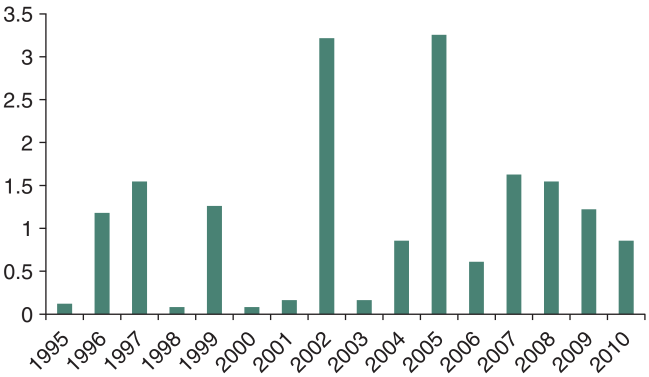
Georgia is vulnerable to natural hazards, including floods, droughts, landslides, avalanches, debris flows, and mudflows. Floods and droughts represent 34 percent of the total statistically reported disaster events during the period 1988–2007 (Pusch 2004). Global climate trends indicate that natural disasters will remain a significant risk for Georgia. Studies indicate that there is correlation between the level of impact of natural disasters and the level of economic development. High-income countries that are financially strong and have better technological resources can better manage the risk as well as impact of natural disasters. In that sense, Georgia's developing economy of a middle-income country is highly exposed to impacts of natural disasters. The economic impact of a natural disaster in Georgia can be much higher than in either a high-income or a low-income country (CENN 2012).

Natural disaster occurrence is highly uncertain. Floods, storms, landslides, rock falls, snow avalanches, wild fires, droughts, and mudslides are a significant source of natural hazard and damage for human health, agriculture, real estate, infrastructure, and personal property. A 2012 study estimated the annual risk from natural disasters in Georgia (CENN and ITC 2012). Further, a regional study of CENN indicates that economic loss due to realization of these risks during 2001–07 is estimated at US$337 million (EM-DAT n.d.). The World Bank estimated the potential economic cost as between US$89.5 million (World Bank 2009, 34) and US$4 billion (Pusch 2004). The level of exposure is different across regions, with higher concentration of natural disaster risks in the mountainous regions of the country.

Natural disasters disrupt economic development prospects, aggravate regional conflicts and instability, and threaten the lives and livelihoods of local people. These risks are aggravated by poverty, unsustainable natural resource management, and improper agricultural practices, as well as by climatic factors. Only natural disasters usually associated with anthropogenic activity, like deforestation, improper agricultural practices, and climate change, are included in the cost of natural disasters estimated in this report.

There are different ways to include the cost of natural disasters. Given limited annual data available for direct GDP

FIGURE 3.9. MAGNITUDE OF INDIVIDUAL FLOOD EVENT DAMAGE AS A MULTIPLE OF STANDARD DEVIATION, 1995–2010



Source: Estimated by authors based on CENN and ITC 2012.

loss and causalities on a national level for a relatively short time period (14 years), the severity of natural disasters distribution is assessed.

Figure 3.9 demonstrates the magnitude of an individual event of flood damage, expressed in multiples of standard deviation (SD). The years 2002 and 2005 are outliers with a significant deviation of flood damage from the mean. Yet in 1995, 1998, 2000, 2001, and 2003 flood damage was relatively low. This analysis reflects an uneven distribution of flood damage over time. Then it is plausible to predict 1 SD and 2 SD events during any selected year that corresponds to low and high estimates.

Table 3.5 presents the estimated risk of an annual damage for natural disasters associated with anthropogenic activity in Georgia.

The total cost of natural disasters (physical damages and causalities) is estimated at US$24 million to US$117 million, or 0.2–0.7 percent of GDP in 2012. The annual economic loss indicates that national policies need to devote attention to creating the capacity to manage and reduce the risks and impacts of natural extreme events and to reduce the underlying environmental causes.

AIR QUALITY

The existing institutional and legal structure for management of the ambient air quality needs an effective enforcement mechanism. The Georgian population is exposed to one or more major environmental health risks. Particulate matter is the outdoor air pollutant that globally is associated with the largest health effects. The major ambient air pollutants monitored in Georgia include particulate matter (total suspended particulates [TSP]), carbon monoxide (CO), nitrogen oxides (NO_2, NO), and sulfur dioxide (SO_2). Air samples at the

TABLE 3.5. ESTIMATED ANNUAL DAMAGE FROM NATURAL DISASTERS IN GEORGIA

	Number of Buildings	Area (km^2)	GDP (mln, GEL)	Roads (km)	Crops (ha)	Protected Area (ha)
Floods	5,780	106	399	173	25,879	117
Landslides	139	56	0.3	2	6	1
Mudflow	75	30	0.3	2	6	5
Rockfall	1	1	0	1	0	1
Snow avalanches	2.9	27	0.25	1	0	15
Wild fire	5.9	7	10	1	896	304
Droughts	0	0	876	0	55,340	33
Hailstorm	38	8	37	0	5635	60
Total	6,042	235	1,323	180	87,762	536
Mean annual 50 years	121	5	26	4	1,755	11
Mean annual 50 years +1 SD	230	9	50	7	3,335	20
Mean annual 50 years +2 SD	643	25	141	19	9,338	57

Source: Authors' estimates for the mean and mean +1SD and mean +2SD based on CENN and ITC 2012.
Note: mln, GEL = Georgian Lari millions.

observation points are taken three times a day and only on working days (sampling is not automated except in one station in Tbilisi).

The national air quality standards establish maximum allowed concentrations of harmful substances in ambient air. MAC of a substance in ambient air represents the concentration (averaged for a specific time period) below which the substance does not affect human health or the environment over a regular period or lifetime exposure. Two types of MACs are established: a maximum one-time concentration (measured within 20–30 minutes interval, in microgram per cubic meter) and mean daily (24-hour) concentrations (μg/m^3). The average annual concentrations are also measured based on the mean daily concentrations. The MACs for air pollutants established in the air quality regulations are based on former Soviet standards of air quality, and in some cases they differ from standards recommended by WHO as well as from the standards adopted by the EU. Figure 3.10 provides types and values of MACs for selected air pollutants and corresponding standards of the WHO and the EU.

WHO recently reduced its guideline limits to an annual average ambient concentration of 10 μg/m^3 of $PM_{2.5}$ and 20 μg/m^3 of PM_{10} in response to increased evidence of health effects at very low concentrations of particulate matters.[9] Some 73 percent of the population in Georgia is estimated to be exposed to high levels of $PM_{2.5}$; the other 27 percent are still exposed to air pollution, but at a lower level.

The most substantial health effects of $PM_{2.5}$ are cardiovascular disease, chronic obstructive pulmonary disease, and lung cancer among adults and acute lower respiratory infections among young children (Lim et al. 2012; Mehta et al. 2013; Pope et al. 2009, 2011). Additional mortality is estimated using an integrated exposure-response relative risk function. The results of estimates of additional mortality are presented in table 3.6.

Additional morbidity is estimated proportionally from loss of DALYs because of additional mortality and additional morbidity as presented in WHO's *Global Burden of Disease*

[9] $PM_{2.5}$ and PM_{10} are particulates with a diameter smaller or equal to 2.5 and 10 micrometers (μm), respectively

FIGURE 3.10. AMBIENT AIR QUALITY STANDARDS (μg/m^3) COMPARED WITH WHO AND EU AIR QUALITY STANDARDS

Substances	Georgia	WHO	EU	Concentration Averaging Period
$PM_{2.5}$	—	10	25	1 year
	—	25	—	24 hours
PM_{10}	—	20	40	1 year
	—	50	50	24 hours
TSP	500	—	—	24 hours
	150			1 hour
O_3	—	100	125	8 hours
	30	—	—	24 hours
	160	—	—	30 minutes
NO_2	40	40	40	1 year
	200	200	200	1 hour
SO_2	50	20	125	24 hours
	—	500	—	10 minutes
	500	—	—	30 minutes
	—	—	350	1 hour
Lead	—	0.5	0.5	1 year
	0.3	—	—	24 hours
	1	—	—	30 minutes

Source: http://www.who.int/mediacentre/factsheets/fs313/en/; http://ec.europa.eu/environment/air/quality/standards.htm; http://www.zoinet.org/web/sites/default/files/publications/SEIS/enpi-seis-country-report_georgia_final.pdf.

2012. Additional mortality in different exposure groups and corresponding exposed populations is presented in figure 3.11.

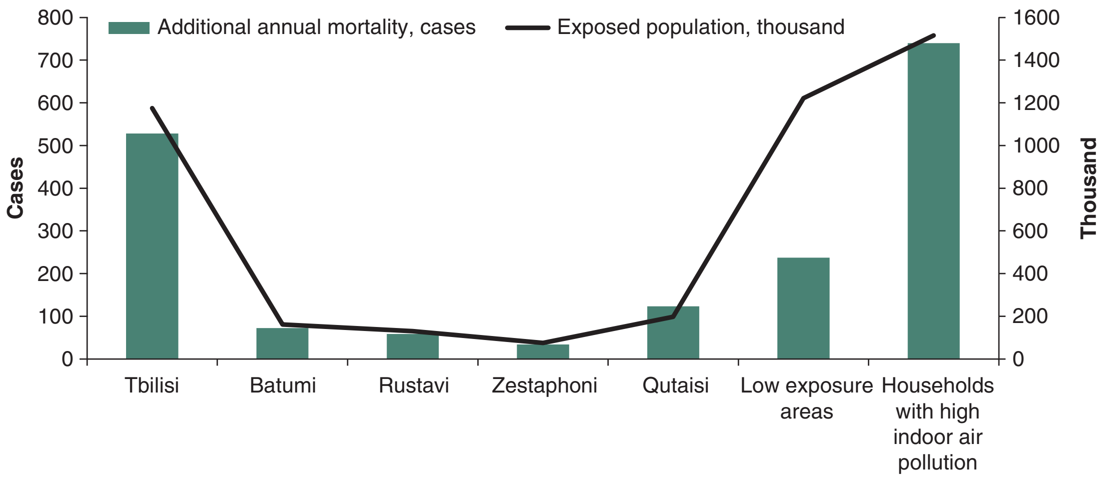
Currently, ambient air quality monitoring is conducted at eight stations located in five cities: Tbilisi, Kutaisi, Batumi, Zestafoni, and Rustavi. (See figure 3.12.) Four stations are located in Tbilisi, but not all operate at full capacity, and only limited parameters are being measured. Only TSP annual average concentrations were provided for an environmental health impact assessment. Air samples at the nonautomated observation points are taken three times a day on weekdays only (sampling is not automated). These concentrations were adjusted to come up with $PM_{2.5}$ annual average concentrations in the same way as in Larson et al. (1998), where similar concentrations have been adjusted in Russia.

TABLE 3.6. ESTIMATED ADDITIONAL MORTALITY, EXPOSED POPULATION, AND ADDITIONAL MORTALITY PER 1,000 EXPOSED POPULATION IN GEORGIA

	Estimated Annual Average $PM_{2.5}$ Concentration (μg/m^3)	Additional Annual Mortality (Cases)	Exposed Population (Thousands)	Additional Annual Mortality/1,000 Population Exposed
Tbilisi	41	528	1,175	0.45
Batumi	40	72	161	0.45
Rustavi	41	58	130	0.45
Zestafoni	38	34	75	0.45
Qutaisi	77	124	197	0.63
Low-exposure areas	15*	237	1,222	0.19
Households with high levels of indoor air pollution	100–400	740	1515.25	0.49

Source: Authors' estimate from Georgia monitoring data and WHO Global Burden of Disease 2012 maps for the low-exposure areas.

FIGURE 3.11. ESTIMATED ADDITIONAL MORTALITY ASSOCIATED WITH AIR POLLUTION IN GEORGIA



Source: Authors' estimate.

Automobile transport and the energy sector (municipal heating) are major sources of particulate pollution. Therefore, measures for pollution reduction should be focused on transportation sector. Developing an inventory of particulate emissions would allow apportionment of emission sources and benefit and cost analysis of local pollution abatement interventions.

It is estimated that 70–80 percent of the rural population uses solid fuels for cooking (Georgia MICS 2005 Survey). It is likely that most of this population is exposed to household pollution from burning solid fuel at levels on average 30 times over the minimum level. Several assumptions have been made: first, that mostly improved stoves are used in Georgia, and that 90 percent of the 72.5 percent rural population use solid fuel for cooking (World Bank 2014b). In the absence of indoor air pollution studies in Georgia, the average annual concentration of $PM_{2.5}$ is approximated at 100–200 μg/m^3 for households with improved stoves (90 percent of households) and at 200–400 μg/m^3 for the 10 percent of the households with unimproved stoves or low-quality improved stoves and/or poor ventilation.

The cost of mortality is based on the value of statistical life (VSL). The range in cost is the result of the uncertainty of monitoring data in Georgia and the different elasticity of

FIGURE 3.12. A MAP OF AMBIENT AIR QUALITY MONITORING STATION IN GEORGIA

Source: EEA 2011.

willingness to pay to avoid health risks applied in benefit transfer as the Organisation for Economic Co-operation and Development (OECD) suggested (Navrud and Lindhjem 2011).

Comp: align turnover lines in tables rather than hanging them

There are no reliable studies of VSL conducted in Georgia. This implies that values have to be transferred from studies in other countries. The overwhelming majority of VSL studies have been conducted in countries with a different income level than in Georgia. VSL estimates from these countries must therefore be adjusted to Georgia. As Navrud and Lindhjem (2011) suggest, for transfers between countries VSL should be adjusted with the difference in GDP per capita to the power of an income elasticity of VSL of 0.8, with a sensitivity analysis using income elasticity of 0.4.

The study applies a purchase power parity (PPP) coefficient to transfer from OECD to Georgia values. In 2012, the PPP coefficient that should be applied to market exchange rate was about 1.9 in Georgia. Application of PPP for VSL estimation would increase the VSL in Georgia by a factor of PPP—that is, 1.9 times. Then, 0.8 income elasticity was further applied as a commonly used adjustment in benefit transfer in this report.

TABLE 3.7. ESTIMATED VALUE OF STATISTICAL LIFE IN GEORGIA

	VSL			
	PPP	**PPP**	**PPP**	**Source**
*Average VSL in OECD (million US$)**	1.45	1.45	1.45	Navrud and Lindhjem 2011.
Average GDP/capita in OECD (PPP in 2012)	40300	40300	40300	WDI, 2014
GDP per capita in Georgia (PPP in 2012)	6800	6800	6800	WDI, 2014
Income elasticity	0.4	0.8	1	Navrud and Lindhjem, 2011
Estimated VSL in Georgia (million US$)	**0.24**	**0.35**	**0.71**	**Estimated for Georgia**

Source: Estimates by the authors.
*Adjusted with Consumer Price Index (WDI 2014).

Table 3.7 presents the VSL for Georgia from benefit transfer based on the average VSL reported by Navrud and Lindhjem (2011), with PPP and an income elasticity of 0.8 or 0.4. We applied elasticity 1 as an upper bound.

TABLE 3.8. ESTIMATED ANNUAL COST OF HEALTH IMPACTS ASSOCIATED WITH PARTICULATES (US$, MILLIONS)

Health Categories	Low	Average	High
AAP	282	402	820
HAP	198	282	576
TOTAL COST	480	685	1,395
Total cost (% GDP)	3.0%	4.3%	8.8%

Source: Estimates by authors.

Using these, a value for VSL in Georgia is estimated at between US$0.24 million and US$0.71 million. The estimated annual cost of health impacts in Georgia is presented in table 3.8.

Lead exposure poses multiple health risks. Increased levels of lead could be traced in and measured in blood lead levels (BLLs). Increased BLL is associated with adverse health consequences, including cognitive and behavioral deficits (Fewtrell, Kaufmann, and Pruss-Ustun 2003). Since the official ban in 2000 (UNEP 2012), the phase-out of ambient lead concentrations is taking place gradually, with annual average lead concentration of 0.7 μg/m^3 in 2007 and below 0.3 μg/m^3 in 2014 (see table 3.9).

Although there is no recent research of lead blood levels in children and adults, studies published a few years ago associate lead exposure with the use of leaded gasoline and point out that the BLL should be at a sizable level (Cooperation for a Green Future 2008).

A regression model for BLL approximation (Attina and Trasande 2013) was developed to estimate mean BLL in children under 5 years of age if BLL information is not readily available.

Georgia imports gasoline from different countries, mainly from Azerbaijan, Russia, Romania, and Bulgaria. (See figure 3.13.) Based on information on the lead phaseout in these four leading exporters of gasoline to Georgia (UNEP 2012), and assuming that the time lag of lead phaseout is 12 years for other countries (when Georgia started to enforce its lead phaseout legislation; see box 3.1), then weighted mean BLL in children under 5 in Georgia is 3.2 μg/dL and the standard deviation is 3.35 μg/dL.

Applying a log-normal distribution of BLL to the child population in Georgia (Fewtrell, Kaufmann, and Pruss-Ustun 2003), it is estimated that 65 percent of children under 5 years of age have a BLL of ≥2 μg/dL. (See table 3.10.)

The latest studies suggest that a loss of cognitive abilities is associated with a BLL ≥2 μg/dL in children. Then the loss of IQ is estimated for children under 5 in different BLL groups (based on Fewtrell, Kaufmann, and Pruss-Ustun 2003); the population at risk is represented by each one-year cohort of children under 5. Total annual losses of IQ points among children under 5 years of age in Georgia are estimated at about 150,000. (See table 3.11.)

An individual's income is associated with the person's IQ score. This has long been empirically established by, for instance, Schwartz (1994) and Salkever (1995). These two studies found that a decline of one IQ point is associated with a 1.3–2.0 percent decline in lifetime income.[10] Studies of the cost of lead exposure, or of the benefit of lowering BLL in children, have applied the findings by Schwartz and Salkever in low- and middle-Income countries (Attina and Trasande 2013).

The present value of the future lifetime income of a child under 5 is estimated at US$108,000, based on an estimated average annual income in 2012 of US$3,550 in Georgia.[11] The cost of lost IQ points in Georgia is estimated as the product of income loss per lost IQ-point (mid-point estimate in Schwartz [1994] and Salkever [1995]) and the percentage of children that may be expected to participate in the labor force (67 percent in Georgia, from World Development Indicators). Expected labor-force participation is assumed to be the same as the current rate of participation. Total annual cost of lead exposure in Georgia is estimated at US$147–US$218 million, with a midpoint

[10] The high bound reflects the estimated loss in income in Salkever (1995), weighted by the labor-force participation rates in Georgia.

[11] The present value is estimated based on a discount rate of 3 percent and a real annual future income growth of 2 percent, assuming that real income in the long run grows at a rate close to the growth rate of GDP per capita.

TABLE 3.9. GEORGIAN STANDARD FOR LEAD IN AIR

Name of Harmful Substance	Maximum Permissible Concentrations mg/m³ National Legislation	Recommended by WHO	According to EU Legislation	Concentration Averaging Period
	-	0.0005	0.0005	1 year
Lead compounds	0.0003			1 day
	0.001			30 min

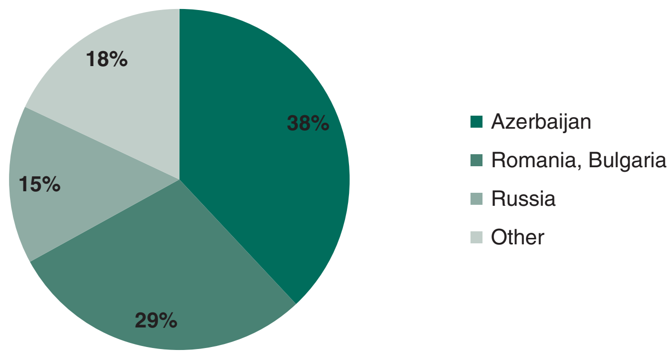
Source: National Report on the State of the Environment Report Georgia 2007–09.

BOX 3.1. LEADED GASOLINE IN GEORGIA

Georgian law mandated the maximum lead content in gasoline of 13 mg/liter in 2000. Under a scheduled phaseout of lead in gasoline in 2007, the maximum allowable lead concentration was established at 5 mg/liter, which was later delayed until 2012 because of difficulties with enforcement and possible negative social factors. However, despite the official standards for gasoline lead concentration, no action is currently being taken by the Georgian government to enforce gasoline quality. According to the Georgian Law on Traffic Safety, in 2004 the annual mandatory inspection of emissions and technical conditions of private vehicles became voluntary until January 2007. Since then, however, the government has not reimplemented mandatory inspection, and citizens are not eager to have proper vehicle inspection, including emissions control that would improve air quality.

Source: Cooperation for Green Future 2008.

FIGURE 3.13. SHARE OF GASOLINE IN GEORGIA EXPORTED FROM SELECTED COUNTRIES, 2012



Source: Estimated by authors based on International Trade Centre, www.trademap.org/tradestat/Country_SelProductCountry_TS.aspx.

TABLE 3.10. ESTIMATED CHILD BLOOD LEAD LEVEL DISTRIBUTION IN GEORGIA, 2012

BLL (μg/dL)	Children Under 5 (%)
0–2.0	36
2–5	30
5–10	18
>10	17

Source: Estimates by the authors.

of US$183 million. This is equivalent to 0.9–1.4 percent of Georgia's GDP in 2012, with a midpoint estimate of 1.2 percent of GDP.

WASTE MANAGEMENT

In 2006–07 a national waste inventory was conducted in Georgia with support from the UN Development Program. The study identified 63 landfills with an overall area of about 300 hectares in Georgia. It also found 28 unregulated dump sites that are uncontrolled sources of local pollution. Often such sites are close to settlements, cultural monuments, rivers, and the sea (Chikviladze 2007). Figure 3.14 presents the locations of regulated and nonregulated landfills in Georgia.

In 2007, the total generated waste was more than 17 million m^3 (ENPI National Action Program 2010), of which 13.9 million m^3 was industrial waste including 0.9 million m^3 hazardous waste, and 3.4 million m^3 municipal waste. Annually, the average waste generated per capita is about 0.7 m^3. A common practice is dumping waste close to water bodies, along roads and railways,

TABLE 3.11. ESTIMATED ANNUAL LOSSES OF IQ POINTS AMONG CHILDREN <5 YEARS IN GEORGIA, 2012

BLL (µg/dL)	IQ Losses
<5	35,000
5–10	46,000
>10	69,000
Total	150,000

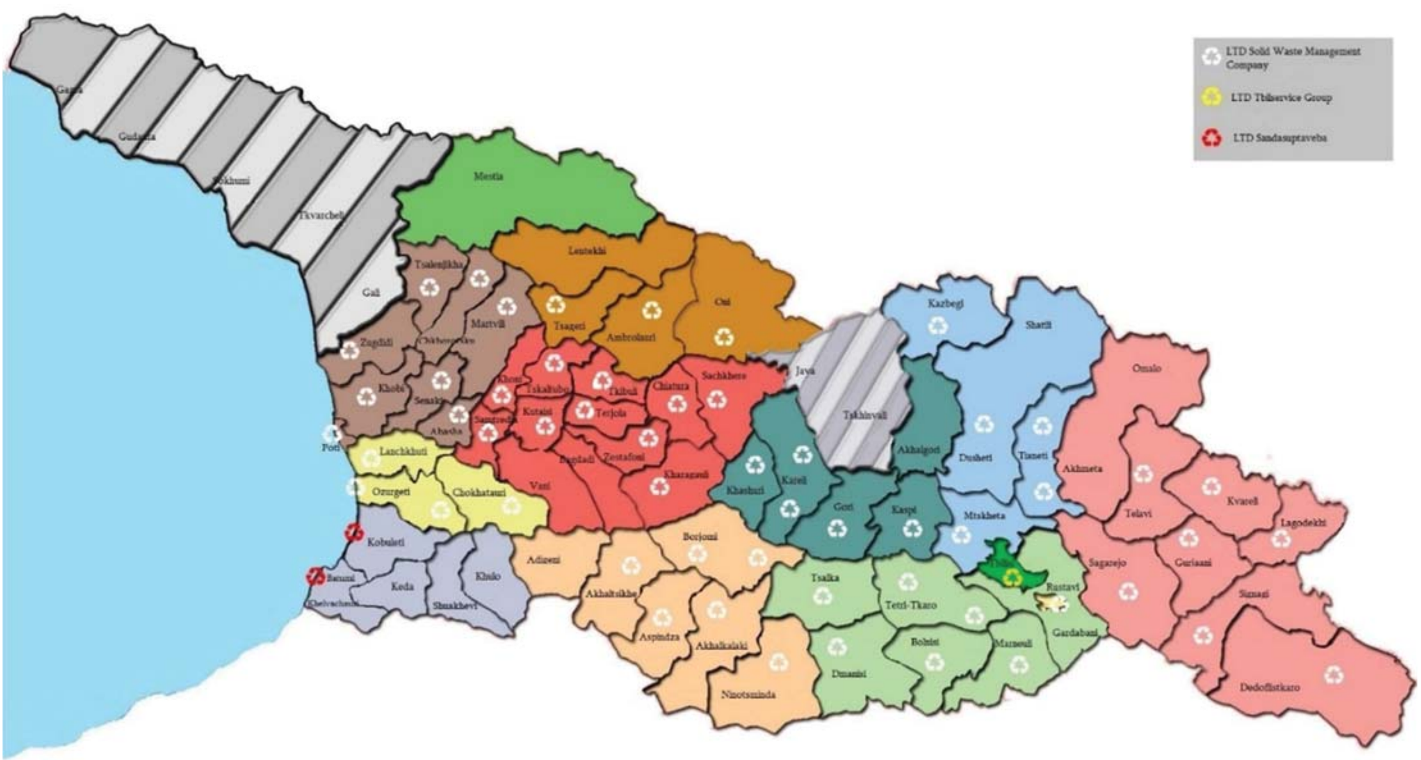
Source: Estimates by the authors.

forests, and so on. Not only does this generate significant pollution to soil and watercourses, but often waste self-ignites and becomes a source of toxic pollutants and greenhouse gases. Only Tbilisi and Rustavi have daily waste monitoring practices, whereas in other municipalities there is no or an insufficient registration system.

If waste is not properly collected, it carries health risks as well as being an eyesore and unpleasant to be near. As a rule of thumb, the figure of 1 percent of the income of people in the areas where there is no collection is used as a guide to this cost (Mani et al. 2012). It is assumed that 30 percent of the population has no official solid waste collection service. Thus, about US$53 million is lost annually because of this lack of collection in Georgia.

Improper management of waste disposal sites gives rise to a number of environmental costs. Scavengers operating on open landfill sites, without proper facilities and equipment, are typically exposed to a range of public health and environmental hazards. During periods of rain, stagnant water ponds are commonly found on such sites. These serve as breeding grounds for mosquitoes. Such sites also attract large rodent populations that carry fleas. Diseases contracted by scavengers can then be spread more generally through the population. The most common health risks are eye irritation, tuberculosis, diarrhea, typhoid, dysentery, coughing, and scabies. Expired packaged foods disposed of at the landfill sites are a particular problem, because they are consumed by scavengers. There are no data available to estimate this cost component.

FIGURE 3.14. MUNICIPAL SOLID WASTE LANDFILLS IN GEORGIA



Source: National Environmental Agency 2012.

TABLE 3.12. ESTIMATE OF ANNUAL LOSS OF PROPERTY VALUE BECAUSE OF PROXIMITY TO A LANDFILL IN GEORGIA*

	Affected Population in 5 km Zone, 2013	Midpoint Capital Cost (US$)	Annualized Cost,** Million (US$, Millions)	Cost Per Exposed Person (US$)
Kvemo Kartli	33,765	4,186,400	0.7	20.2
Guria	29,114	3,253,628	0.5	18.2
Kakheti	87,771	8,190,499	1.3	15.2
Samegrelo	273,267	9,459,008	1.5	5.6
Mtskheta Mtianeti	53,736	2,439,686	0.4	7.4
Samtskhe- Javakheti	38,537	2,020,839	0.3	8.5
Imereti	84,765	14,451,809	2.4	27.7
Racha, Lechkhumi, Kvemo Svaneti	12,438	425,501	0.1	5.6
Shida Kartli	43,206	1,306,792	0.2	4.9
Total	656,599	45,734,163	7.4	

Source: Estimates of the authors based on Jones Lang LaSalle 2012; real estate prices from www.makler.ge.

* Landfills in Tbilisi are not included in the assessment because they are daily monitored and regulated.

**10 years, 10% discount rate.

People living in close proximity of landfill sites face health risks. Migrating landfill gases can cause serious health and safety hazards to the surrounding population. Groundwater can be affected by leaching from such landfills, which have no gas or leachate collection systems. Hazardous waste has also been dumped illegally in some sites (ENPI National Action Program 2010). There are no data available to estimate this cost component.

Waste dumps can release methane, which if not captured, adds to the global burden of greenhouse gases. Because we are not considering GHGs in this study, this element is not considered.

Other environmental problems include soil erosion and soil destabilization caused by excavation, odors and visual impacts, obstruction of development projects in nearby areas or those to be constructed on old landfill, hazards from opening abandoned landfills caused by gas escapes from earth cracks, detrimental impacts on wildlife populations and habitat destruction in a scarce terrestrial environment, and air pollution and dust during the operation of landfill sites. There are no data available to estimate this cost component.

Even if a landfill is well maintained and run, people do not like to live close to it, and property values are lower near the site. This loss has been studied in depth in the United States and Europe. The value of the amenity loss is made through a decline in the value of housing around the site. Estimates of the rate of decline of land and house prices closer to a landfill site are generally found to be significant. A survey of the studies was carried out by Walton et al. (2003). Based on a wide range of studies, they concluded that a loss rate of about 4.2 percent per kilometer is found as you get closer to a disposal site. The distance at which there is no impact is about 5 kilometers. But the range of loss is wide, with estimates ranging from 0.4 percent to 17.6 percent. Factors that are important in determining this rate include the size of the landfill, the population density, and median income.

For the CEA, information was collected for all official and nonofficial landfills on people living within 5 km. Data on property value data was acquired from makler.ge. Jones Lang LaSalle (2012) reports that the average dwelling space per person is 6.8 sq m. Then it is assumed that property value will decline 4–12 percent in the vicinity of a landfill. Midpoint estimates of the annual loss of property value caused by proximity to a landfill are presented in table 3.12.

Thus, an annual estimate of lost value of assets caused by proximity to a landfill is in the range US$3.7–US$11.1 million. The total estimate of costs of poor solid waste regulation in Georgia is in the range US$57–US$64 million, or about 0.4 percent of GDP in 2012.

TABLE 3.13. MINING SECTOR IN THE ECONOMY OF GEORGIA, 2012

Indicator	Value in 2012
GDP	US$15.8 billion
GDP growth rate (real)	6.1%
Share of industrial production in GDP	17.2%
The share of mining in industrial production	5%
The real value of manufactur[illegible] growth rate	16.4%
The real value of productio[illegible] growth rate	2%
Total FDI	US$865 million
The FDI in mining	US12.7 million
Trade deficit	US$5.46 billion
Export	US$2.38 billion
Share in export - Ferroalloys;	11%
- Nitrogenous mineral or chemical fertilizers;	5.8%
- Unwrought gold;	5.0%
- Copper ores and concentrates	2.3%

Comp: align turnover lines in tables rather than hanging them

Comp: These are not subentries and may remain indented

Source: National Statistics Office of Georgia 2013; U.S. Central Intelligence Agency 2013.

BOX 3.2. MANGANESE ORE PRODUCTION IN GEORGIA

Chiatura deposit is the major source of manganese ore. A portion of the ore was used to produce manganese ferroalloys (ferromanganese and silicomanganese) at the Zestafoni ferroalloys plant, which was located 28 km from the Chiatura deposit. Chiatura Manganese included four mines and three open pit quarries; the enterprise's annual production capacity was about 400,000 tons. In 2006, both the Chiatura Manganese Mine and the Zestafoni plant were a part of Georgian Manganese Holding, LLC. In October 2012, Georgian American Alloys, Inc., of the United States acquired 100% ownership interest in the Chiatura Manganese Mine, the Zestafoni ferroalloys plant, and the Vartsikhe hydroelectric facility, which powered the Chiatura Mine and the Zestafoni plant. In 2012, employees of Georgian Manganese Holding, LLC in the city of [illegible] a wage increase [illegible]

Source: Safirova 2013.

MINING INDUSTRY AND ENVIRONMENTAL HEALTH

The mining industry in Georgia has a long history, but it has not been developing at the same rate as other industries. Georgia's output of ferrous and nonferrous metals, ferroalloys, industrial minerals, and fuels is second only to agriculture in terms of GNP (Levine and Wallace 2004). The country has more than 300 explored mineral deposits—copper, iron ore, barite, lead, zinc, arsenic, clay, sand, gravel, and a range of secondary metals, including gold and silver—only about half of which have been brought into production.

Georgia has been a major producer of high-grade manganese (Mn) for about a century. It has one of the world's richest Mn deposits and largest Mn mining areas in the foothills of the Caucasus Mountains near the city of Chiatura, in the Imereti region of Western Georgia. The U.S. Geological Survey indicates (2012) that although the growth rate of the real value of manufacturing in Georgia was 16.4 percent, it was only 2 percent for mining. (See table 3.13.) In 2012, mining contributed to less than 1 percent of GDP. At the same time, mining products have a significant share in export (about 24 percent). Ferroalloys were a major export good in Georgia in 2012. (See box 3.2.) Because Georgia had a substantial trade deficit at about 30 percent of GDP in 2012, the export potential of mining is very important to maintain a healthy macroeconomic situation in the country.

Although the Chiatura Manganese Mine and the Zestafoni plant are important for the county's trade balance, they also have significant environmental impacts, including acid mine drainage in some areas and contamination of groundwater, surface water, and soils (Caruso et al. 2011). Tables 3.14 and 3.15 provide data on the annual average concentrations of heavy metals in water and manganese and of dust in ambient air in the area of the Zestafoni mine. Manganese can be toxic to humans through exposure routes that include ingestion, dermal exposure, and inhalation of particulate forms in air. Manganese compounds are well-known neurotoxic substances. They are linked to severe neurological disorder characterized by disturbances of movement, as well as to Parkinson's disease (Caruso et al. 2011). These risks can be particularly high in Georgia given the lack of regulations and pollution control and the high density of poor communities around mines, processing facilities, and waste piles, as well as downstream.

Comp: align turnover lines in tables rather than hanging them

TABLE 3.14. ANNUAL AVERAGE CONCENTRATION OF HEAVY [illegible]ALS IN THE WATER FOR [illegible] (mg/L)

	Fe	Zn	Cu	Mn
River Kvirila-Zestafoni upstream	0.4246	0.0760	0.0330	0.4230
River Kvirila-Zestafoni downstream	0.2784	0.0511	0.0103	0.2283

Source: National Environmental Agency 2013.

TABLE 3.15. ANNUAL AVERAGE CONCENTRATION OF TOTAL SUSPENDED PARTICLES AND MANGANESE IN AIR FOR 2012 (μg/m^3)

	TSP	MnO_2
Zestafoni area	458	6.8

Source: National Environmental Agency 2013.

A 2011 study evaluated the effects of manganese mining on water quality in the Chiatura region (Caruso et al. 2011). However, more data are required to assess the exposure and health risk associated with mining activity in Georgia. The study assessed water quality in the area of the Kvirila-Zestafoni river basin and suggested that a major health risk is associated with the chronic or acute inhalation by occupational workers and nearby residents of manganese-contaminated dust particles from mines, processing facilities, and solid waste materials. Solid mine waste (tailings and waste rock) have been disposed of on the floodplain surface along the Kvirila River and some tributaries. The on-site waste material is a significant source of metals that will continue to affect water quality and the ecological health of the Kvirila River and some tributaries. Industrial mine waste from the enrichment and processing plants needs to be managed in a way that isolates the material from rivers and groundwater. Only dust pollution is monitored in Zestafoni, and the level of ambient air pollution there is among the highest in the country (see the section on air pollution). The health risk from exposure to ambient air pollution in Zestafoni is estimated in this report at 34 additional cases of mortality annually, which is a high estimate for a city with a population of about 75,000.

The same study provides a list of immediate recommendations to reduce a potential health risk (Caruso et al. 2011). These could gain more support if the economic cost of environmental health losses from mining were estimated in a follow-up study.

CHAPTER FOUR
MACROECONOMIC DIMENSIONS OF ENVIRONMENTAL DEGRADATION

SELECTED INDICATORS OF COED FOR THE MACROECONOMIC ANALYSIS

This chapter aims to quantify major environmental externalities stemming from the economic value creation, using COED available data on air pollution, exposure to lead, and environment-related natural disaster risk. Externalities such as waste, deforestation, and land degradation were analyzed earlier but are intentionally left out of the macroanalysis either because of the lack of reliable data on their impact on productivity or because of the absence of a methodology that could link them to a standard growth analysis. The environmental degradation and risks analyzed here explain 80 percent of the environmental degradation in Georgia in 2012.

The methods used in COED and CGE analysis differ: the COED expresses environmental damage in each sector under consideration (land degradation, deforestation, natural disasters, and so on) in static terms (for a given year); the CGE analysis uses elements from COED to quantify the fall in their contribution to the economy (degradation of natural resources and air pollution) in terms of economic flows (value added, production, and so on) to estimate the effect of changes in the sectors affected by environmental degradation in the rest of the economy. For instance, the COED estimates the monetary loss caused by premature death from respiratory diseases, whereas the CGE analysis quantifies the GDP loss caused by the premature death of these individuals in terms of their contribution to the economy as the foregone labor force.[12]

The most significant impacts on health are caused by poor air quality and high levels of $PM_{2.5}$ in larger cities. (See table 4.1.)

[12] Growth means an increase in GDP, which represents the monetary value of all goods and services produced within a country in a given year. Factors of production (such as labor and capital) and intermediate inputs are used in the production process, but its impacts on the environment as emissions, waste, disease, or mortality are not accounted in the standard definition of the GDP.

TABLE 4.1. PREMATURE MORTALITY CAUSED BY PM IN THE MAIN GEORGIAN CITIES, 2012

	Population, 2012 (Millions)	Estimated Annual Average $PM_{2.5}$ (µg/m³)	Estimated Attributed Cases of Annual Mortality
Tbilisi	1,175	41	[illegible]
Batumi	0.161	40	[illegible]
Rustavi	0.13	41*	[illegible]
Qutaisi	0.197	77	124
Zestafoni	0.75	38	34
Other urban areas	0.29	15	56
Total	1,177		873

Comp: align turnover lines in tables rather than hanging them

Source: COED, Authors' calculations.

Additional mortality in the productive age was applied in the CGE model as the foregone urban skilled labor force.

The COED estimates indicate that exposure to lead is associated with about 150,000 total annual losses of IQ points among children under the age of 5. IQ losses were applied in the CGE model to calculate a corresponding reduction of skilled labor productivity regardless of urban or rural area.

Floods and droughts are the main natural disaster causes of GDP loss. (See table 4.2.) The CGE model was used to quantify the damage from natural disasters reported in the Risk Atlas–Georgia (from CENN) into loss of GDP, income, wages, and consumer prices.

Loss of buildings over a 50-year period was applied in the CGE model as a one-time capital stock reduction in 2012, for which year the expected loss was calculated in the COED using a probabilistic method.

METHOD

First, an economywide CGE model (Hertel 1997) was developed for Georgia based on the most recent available socioeconomic and environmental data. Second, the CGE model was used to develop a Business as Usual (BAU) scenario in which no additional measures on pollution control or disaster risk management are implemented.

TABLE 4.2. NATURAL DISASTERS IN GEORGIA

	Buildings (Number)	GDP (GEL, Millions)	Crops (ha)
Floods	5,780	399	25,879
Landslides	139	0.3	6
Mudflow	75	0.3	6
Snow avalanches	2.9	0.25	0
Wild fire	5.9	10	896
Droughts	0	876	55,340
Hailstorm	38	37	5,635
Mean annual 50 years	121	26	1,755
Mean annual 50 years +1 SD	230	50	3,335
Mean annual 50 years +2 SD	643	141	9,338

Source: Adapted by authors; CENN and ITC 2012.

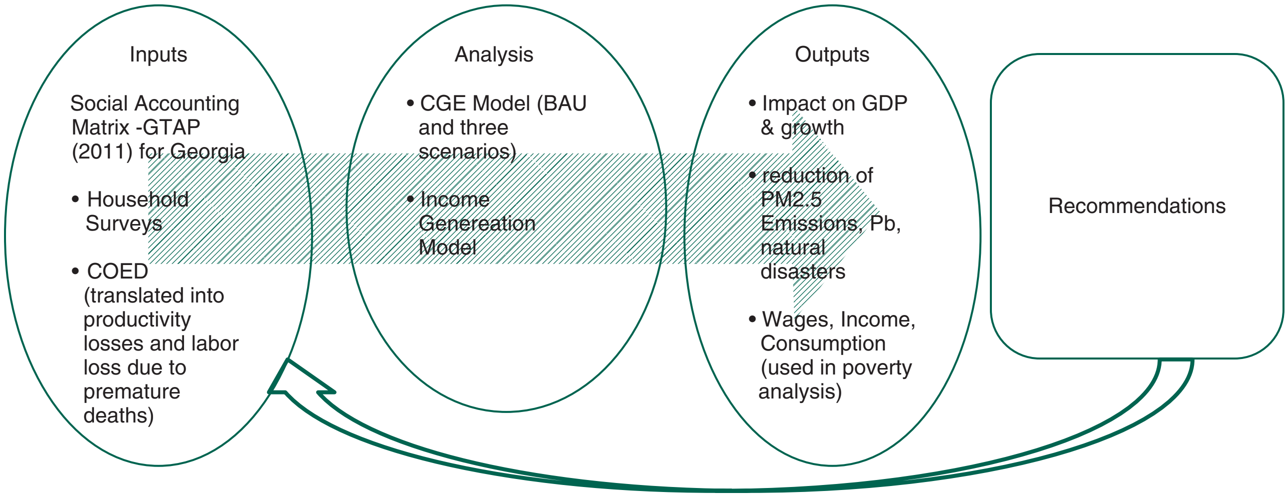
Third, the CGE model was used to estimate the GDP impact of environmental degradation and environment-related disasters (figure 4.1).

The comparison between the Business as Usual scenario and the simulations reflecting COED-adjusted GDP estimates the environmental cost on economic growth going forward. As a pathway of transition to "inclusive green growth," various interventions are modeled.[13] Finally, the benefits/costs for each actionable recommendation from the inclusive green growth matrix are introduced into the CGE framework, and its net benefits are quantified by comparing the results to those in the BAU. The "inclusive green growth" scenarios used in this analysis aim to inform Georgian decision makers about priorities for their interventions and investments for sustainable and inclusive growth.

The method to caculate the macroeconomic impact of COED and poverty incidence in 2012 includes a

[13] In this study, the term *green growth/GDP* refers to the GDP adjusted for environmental degradation. Likewise, inclusive green growth scenarios are ones that meet the criteria for green growth and are clean (expand production/services with minimum pollution), efficient in resource allocation, resilient (reduce vulnerability of assets and services to natural disasters and climate change), and inclusive (alleviate poverty and increase homogeneity of the society). The inclusive green growth matrix is the input–output matrix for development scenarios in Georgia that meets the above criteria.

FIGURE 4.1. METHOD USED IN STUDYING THE MACROECONOMIC IMPACT OF COED AND ITS POVERTY INCIDENCE IN GEORGIA, 2012



CGE–economic baseline that describes the Georgian economy in 2012 and a CGE–environmental baseline, which estimates $PM_{2.5}$ emissions based on the fuel use and production processes described in the CGE analysis for 2012. The economic baseline developed for 2011–12 reflects the current evolution in GDP, value added, wages, incomes, consumer prices, and so on. The method also includes a partial equilibrium–poverty analysis that was developed on the basis of a PE analysis that uses price, income, and wage changes from the CGE for 2011 and 2012.

The static CGE model was developed using GTAP data (for 2011) for Georgia. Each sector in the model is represented by different labor productivity rates. These come from the most recent input–output table developed for Georgia. Two types of labor—skilled and unskilled workers—are represented in the model. Although the CGE and partial equilibrium model for the poverty analysis are linked, the poverty analysis was undertaken outside the CGE model to estimate the distributional impact on different income groups. The CGE analysis using the COED elements provided the wage, income, and price changes.

MACROECONOMIC IMPACT OF ENVIRONMENTAL DEGRADATION

The three main areas in the core of COED selected for the purpose of CGE simulations were ambient air pollution ($PM_{2.5}$), exposure to lead, and impacts of natural disasters (mainly mudslides, floods, and droughts). For these three areas, the annual COED estimate is about GEL 2 billion.

First, a reference (baseline) scenario was developed to describe the Georgian economy in 2011–12. Second, selected inputs from the COED were introduced into the CGE analysis and used to estimate economic losses in terms of GDP, wages, income, and potential impact on consumer prices. The CGE simulations are expressed as deviations from the reference scenario (BAU), where the cost of environmental degradation was not taken into account.

CGE: REFERENCE SCENARIO (BUSINESS AS USUAL)

The Reference Scenario (BAU) represents the country's economy in 2011–12 in line with official statistics. The baseline in 2013–16 projects the most likely evolution of the Georgian economy considering historical trajectories, current government plans, demographic growth, productivity trends, and so on. The Reference Scenario (2013–16) is not a forecast but instead provides a counterfactual—a reasonable trajectory for growth and structural change of the economy in the absence of interventions to improve environmental quality or mitigate disaster risks. The baseline was developed using the Georgia CGE model provided in table 4.3.

During the period 2011–2016 Georgia is expected to grow faster than the world average (5.22 percent per year versus

TABLE 4.3. CURRENT AND PROJECTED GDP GROWTH FOR GEORGIA, 2011–16

GDP Growth %	2011	2012	2013	2014	2015	2016
Georgia	6.95	6.18	3.18	4.99	5.00	5.01
World	4.14	3.37	3.28	3.31	3.85	4.04

Source: WEO, current until 2012, estimates afterward.

3.67 percent for the rest of the world). The difference between the standard growth and the COED adjusted growth trajectories gives a sense on how much the Georgian economy could be better off by investing in effective environmental protection policies. In fact, the model results show that the difference between the world growth performance and Georgia's growth trajectory is reduced almost to zero when the COED is taken into account.

CGE: ENVIRONMENTAL IMPACT SCENARIOS

Air pollution scenario. The adverse health impacts from air pollution concern all categories of the population. The CGE model quantifies the negative impact on the working population in terms of loss in productivity and in the number of workdays. These were applied as a productivity shock to the CGE production module, which translated it to a GDP loss for Georgia. The estimated annual GDP loss associated with ambient air pollution is about 0.48 percent of GDP, per the CGE model. The main population at risk is urban skilled labor, which consists of some 47,360 employees, out of which 1.26 percent die prematurely because of high levels of $PM_{2.5}$.

Lead exposure scenario. The COED suggests a loss of cognitive abilities associated with BLL ≥2 µg/dL in children. Following WHO methodology, a loss of IQ is estimated for children under 5 years old. Therefore, calculated IQ losses per child are translated into a productivity decrease in adulthood. Because every adult was exposed to high levels of lead during childhood, the CGE model is used to estimate a loss of 1.6 percent in labor productivity for every worker (skilled and unskilled). The estimated annual GDP loss is 0.89 percent compared with an alternate scenario in which clean fuels would have been used in households for heating.

TABLE 4.4. RISK ESTIMATES BY NATURAL DISASTERS FOR CGE ANALYSIS

Comp: These are not turnovers and should remain indented

Simulations	Capital Stock (% total)	GDP (%)
Buildings—$30,000	4.5	−1.88
+ 1 SD	4.67	−1.95
+ 2 SD	4.98	−2.08
Buildings—$50,000	7.49	−3.15
+1 SD	7.78	−3.28
+2 SD	8.29	−3.5
	Loss in crops (% total)	**GDP (%)**
Shock (Low intensity)	2.29	−0.23
+ 1 SD	2.37	−0.24
+ 2 SD (High intensity)	2.53	−0.26
Selected simulations	**Loss in capital (% total)**	**Loss in crop yields (% total)**
Low intensity disaster	4.5	2.29
High intensity disaster	8.29	2.53

Source: CENN and ITC 2012.

Environment-related natural disasters scenario. Only natural disasters associated with anthropogenic activity, such as deforestation, improper agricultural practices, and climate change, are included in the COED of natural disasters, whereas the magnitude of an individual event of flood damage is expressed in multiples of standard deviation.

For the impact scenarios, two types of losses were simulated: those caused by loss in cropland and those related to physical damage to capital assets (buildings). First, the damage estimates reported in table 4.4 were simulated to quantify the potential GDP impact. Second, the damage to capital assets as reported in the same table was simulated. In the latter, two values per building were used (US$30,000 and US$50,000).

The minimum and maximum values for the two types of disasters were selected to be used as inputs in the CGE simulations on the combined effect of disasters. Table 4.4 presents the estimated risk of annual damage for natural disasters associated with anthropogenic activity in Georgia with a mean loss of 4.5 percent of the existing building stock in a low-intensity scenario and a loss of

8.29 percent in the high-intensity scenario. Regarding potential crops that may be destroyed, the estimates are between 2.29 percent and 2.53 percent of the 2012 yield. Based on the CGE simulations, the expected combined effect from damage to buildings and cropland in the next 50 years may vary between 4.5 percent and 8.29 percent of Georgia's current capital stock.

To annualize the expected damage from natural disasters (defined as crop loss and damage to buildings), th loss from these two disaster events is defined as on the economy that can surge at any point ove 50 years. In other words, in the absence of an tional aid or grants, the Georgian economy w to finance this amount to recover from a potenti event. This would be equivalent to taking out a loan for 50 years at an interest rate of 3 percent (as is common in cost-benefit analysis) for an amount of 2.11–3.74 percent of the existing capital stock in 2012. In annual terms, this would represent a 0.17 percent loss of the existing building stock in the optimistic (low-intensity disaster) and a 0.32 percent loss in the pessimistic (high-intensity disaster) scenario.

Comp: align turnover lines in tables rather than hanging them

Finally, a GDP indicator accounting for the COED and disaster risk should be corrected for the disaster risk caused by anthropogenic activity. A summary of main results is given in table 4.5. Overall, GDP (2012) growth is in fact 0.25 and 0.33 percentage points lower if accounted for disaster risk. The main vulnerabilities are related to the affected natural resource (for example, mudslides, floods, droughts); hence, agricultural production may suffer a GDP loss of 2.29–2.53 percent from the level in 2012.

According to table 4.3, the predicted average annual growth rate of Georgia is 4.55 percent in 2013–16. Each year, the country would lose 1.36 percentage growth points because of chronic pollution problems (air pollution and exposure to lead) and an almost equal amount of growth is at peril because of natural hazards. Modeling results show that a 50-year disaster event in Georgia could lower its annual growth rate by 1.49 percentage points.

Therefore, in 2013–16 Georgia is projected to grow 4.55 percent in the reference scenario that ignores the COED. The average annual growth rate adjusted for the COED is only 3.19 percent (below the projected world growth rate for the same period of 3.62 percent). Based on the modeling results, Georgia's economic performance can further be reduced to 2.94 percent when the risk of a high-intensity disaster event is taken into account.

TABLE 4.5. SUMMARY OF MACROINDICATORS CORRECTED FOR THE COED AND DISASTER RISK USING THE CGE MODEL (REFERENCE vs. DISASTER SCENARIOS)

Georgia (% Annual Change)			**2012**
GDP Growth—baseline			6.18
GDP CGE—Low intensity disaster			5.33
GDP CGE—High intensity disaster			3.73
Growth (% Annual change)			
For selected sectors	**2012**	**Low Intensity Disaster**	**High Intensity Disaster**
Agriculture	2.55	1.56	−1.26
Manufacturing	2.9	2.93	2.3
Services	4.4	4.38	4.02

In a high-intensity event, agriculture—where one-quarter of the unskilled, low-income workers are active—is projected to face a negative growth rate of 1.26 percentage points.

To support policy formulation for resilient and sustainable growth in Georgia, from the macroeconomic side, the change in GDP owing to the possibility of a natural disaster that affects productivity, especially in agriculture, is simulated using the CGE model. From the microeconomic side, in order to establish the link between environmental degradation and poverty, the analysis assumes that the effects of the natural disaster are transmitted to households through employment, wages, and revenues. These results are presented in the next sections.

ENVIRONMENTAL DEGRADATION, SOCIAL RISKS, AND POVERTY

The theoretical linkages between environmental degradation and poverty are mentioned in several studies (Barrett, Travis, and Dasgupta 2011; Dasgupta and Goran-Mäler

1994; Reardon and Vosti 1995). The rationale behind the linkages between poverty and the environment rely on the dependence of the poor on the environment and natural resources, people's assets, and the institutions involved in the utilization of natural resources, especially in developing countries (Reardon and Vosti 1995).

The link between poverty and the environment is further explained by the poor's dependence on open access resources such as forests, pastures, and water resources that leads to their overexploitation (Jodha 2000). Animals such as sheep and goats that act as capital resource for the rural poor degrade the vegetation and soil faster than the livestock of the richer rural population, such as buffaloes (Rao 1994). Cultivable land degrades quickly because of a lack of investment in maintaining the soil quality that erodes the soil fertility (Reardon and Vosti 1995). The land tenure system can also play a crucial role in the investment in maintaining soil quality. Because the environment is not an amenity but a necessary input for rural households, environmental degradation in turn implies a shrinking input base for the poor households, which increases the severity of poverty (Jodha 2000; Mink 1993). This cyclical relationship is commonly referred to as the poverty-environment nexus (Dasgupta et al. 2003; Duraiappah 1998; Nelson and Chomitz 2004).

The links between poverty and the environment are not straightforward. They are complex and depend heavily on the context and institutional setup, including market structures. As noted by Barret, Travis, and Dasgupta (2011), empirical evidence that might help confirm the theory is minimal and not very rigorous. Therefore, studying the causal effects between poverty and environmental degradation requires linking together an important amount of micro- and environmental data as well as factoring in the level of uncertainty that environmental degradation imposes on the population. When environmental degradation increases the risk of obtaining unfavorable outcomes, such as lower agricultural yields, richer individuals and communities have a better capacity to cope against those risks. Conversely, poor populations usually lack these types of resources and need to rely on less effective mechanisms, whereas wealthier natural resource users generally have a better capacity to diversify the risks of environmental uncertainty. In conclusion, it is not straightforward to accept the "common" notion that poverty leads to environmental degradation, or the "downward spiral" rationale (Scherr 2000). In order to illustrate potential risks that environment degradation could impose on the poor population as a starting point the profile of poor population in Georgia is described.

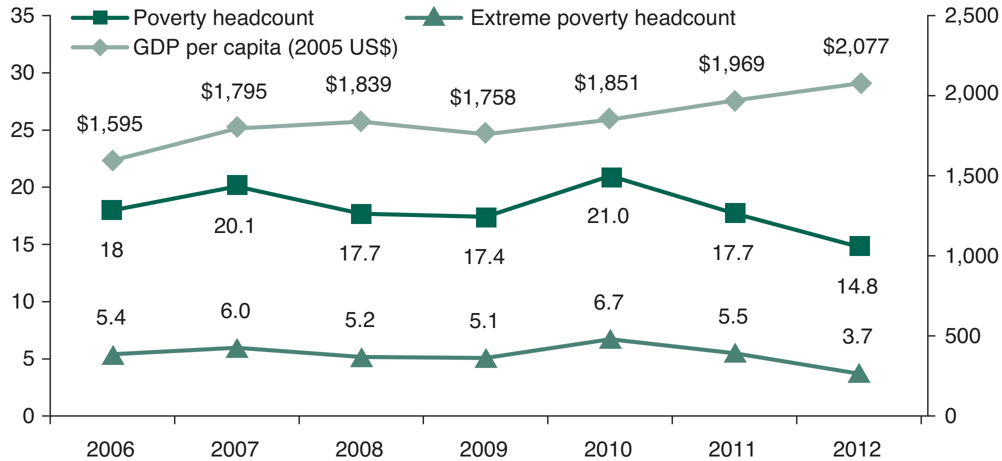
LINKING POVERTY AND ENVIRONMENTAL DEGRADATION IN GEORGIA

Poverty rates in Georgia remained relatively stable between 2006 and 2011, with an important drop in the last year from 17.7 percent to 14.8 percent. Although poverty in Georgia did not experience major changes from 2006 to 2010, it is still considered high in comparison with other European and Central Asian countries. (See figure 4.2.)

As is commonly observed in developing and transitioning countries, poverty in Georgia is concentrated for the most part in rural areas, (see figures 4.3 and 4.4), meaning that the dependence of the poor on natural resources is high. Moreover, in the case of Georgia, 50 percent of the population lives in rural areas, a trend that has not changed over time and one that is likely to sustain the pressure on environmental resources.

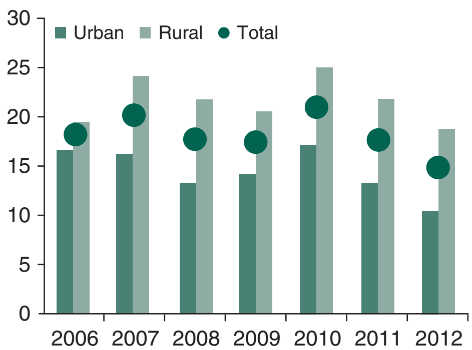
Across the country, the observed fall in poverty between 2010 and 2012 is present in almost all regions, with the sole exception of Kvemo Kartli. (See figures 4.5 and 4.6.) In this context of generalized improvement of living conditions, Kakheti stands out as the best-performing region, with poverty falling from 32 percent in 2010 to 20 percent in 2012; it is no longer the poorest region in the country. In 2012, the regions with the highest incidence of poverty were Kvemo Kartli and the northern mountain arc (Shida Kartli, Mtsheka-Mtianeti, and Kakheti). Harsh terrain and physical isolation in the northern mountain arc make living conditions extremely hard in this region (World Bank 2014b). The regions with the lowest poverty incidence are Tbilisi and Samtskhe-Javakheti.

FIGURE 4.2. TRENDS IN OVERALL AND EXTREME POVERTY RATES, 2006–12



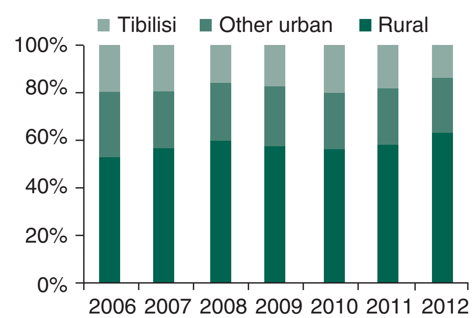
Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.3. POVERTY RATES BY LOCATION, 2006–12



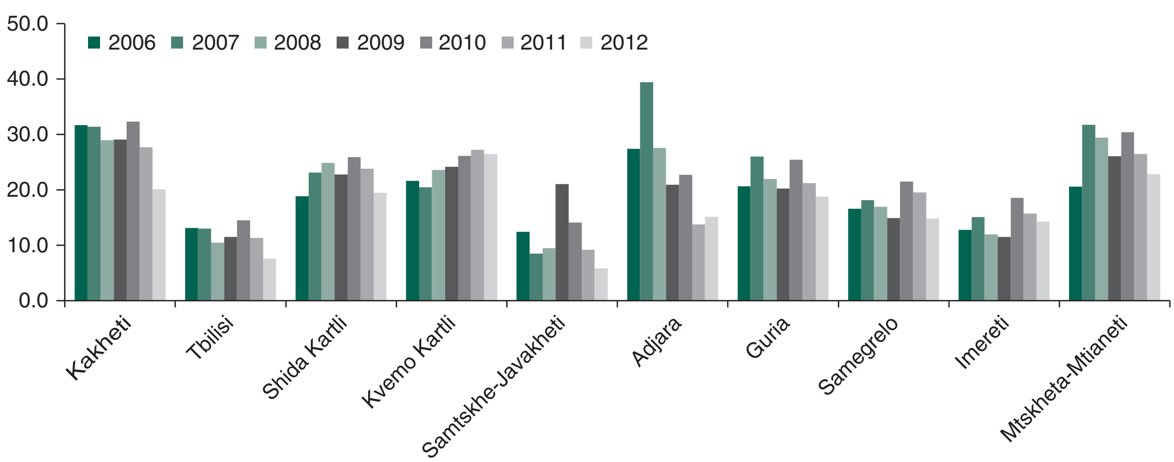
Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.4. SHARE OF POOR POPULATION BY LOCATION, 2006–12



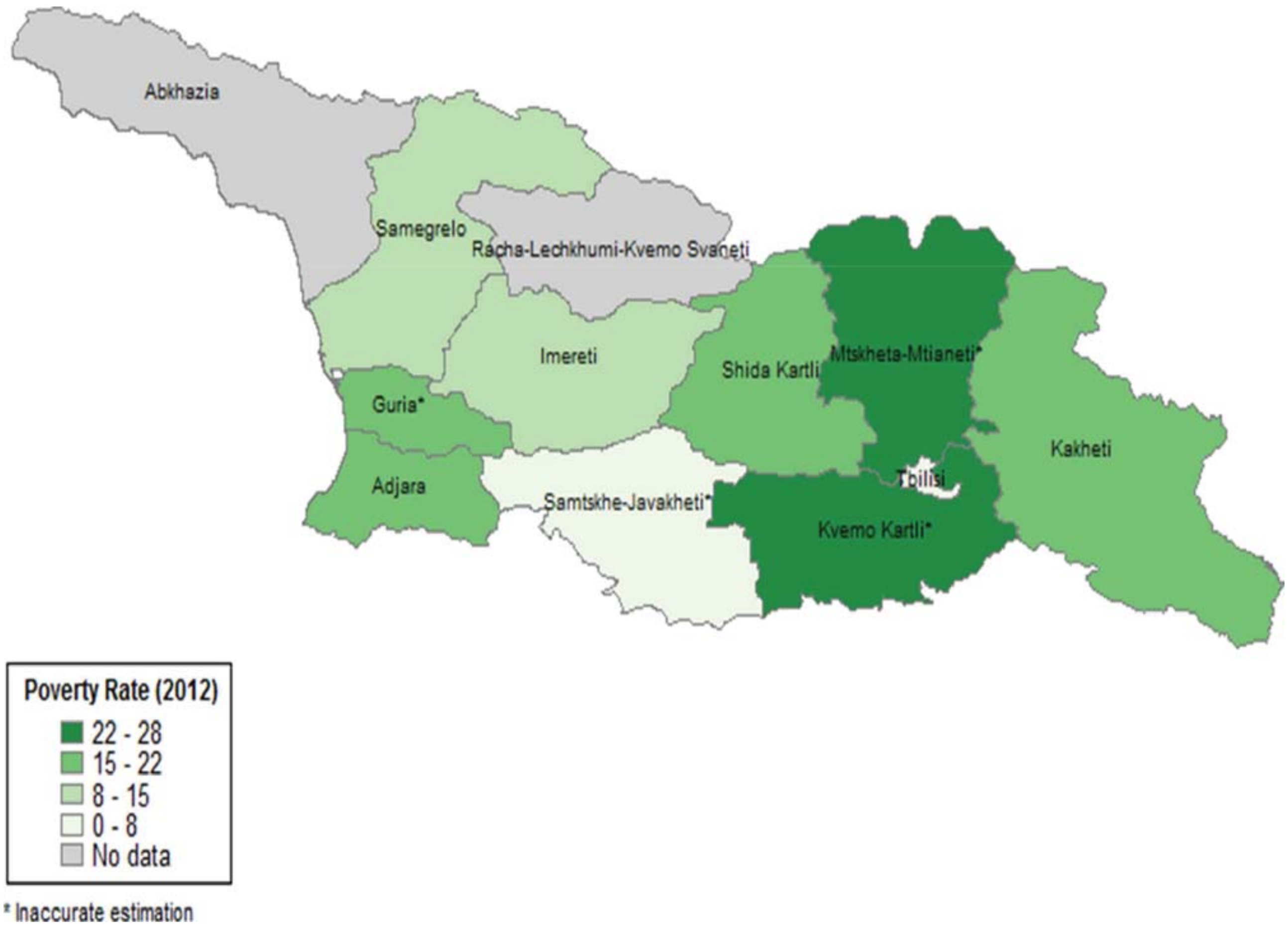
Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.5. POVERTY RATES BY REGION



Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.6. MAP OF POVERTY RATES IN GEORGIA, 2012



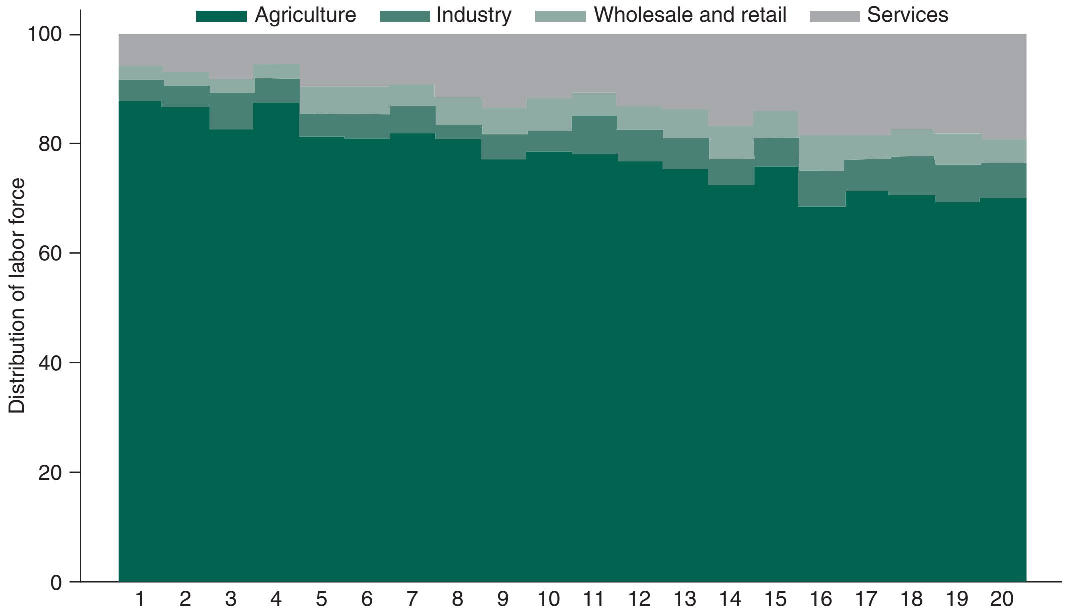
Source: World Bank Staff calculations using Integrated Household Survey data.

As expected, most of rural population works in agriculture. Figure 4.7 shows that participation in agriculture slightly decreases with the level of household consumption per capita, but participation levels are very high, even for the wealthiest households (65 percent of the labor force). For the poorest households (quintiles 1 and 2), the level of participation in agriculture reaches almost 90 percent.

There are differences along the wealth spectrum in expenditure per ha, which could be a signal of higher levels of land degradation at the bottom of the distribution. According to the "downward spiral" idea, farms located at the bottom of the wealth distribution tend to invest less in the land, which might yield land degradation. Unfortunately, it is not possible from the Household Budget Survey to identify land quality at the household level. However, it is possible to calculate household expenditures in agriculture per hectare and the share that these expenditures represent in total household expenditures. Figure 4.8 shows that the share of agriculture expenditures increases slightly as household consumption expenditure increases, represented by quintiles. The Bottom 40 would be represented by households located in quintiles 1 and 2. The differences in the share of agricultural expenses over total household expenditures are not significant. However, the expenditures per ha increase significantly over the consumption range from GEL 18 to almost GEL 40 on average a month per ha. The differences between the lowest quintile and the other four quintiles are statistically significant, suggesting that poorer households spend significantly less per ha than the wealthiest ones.

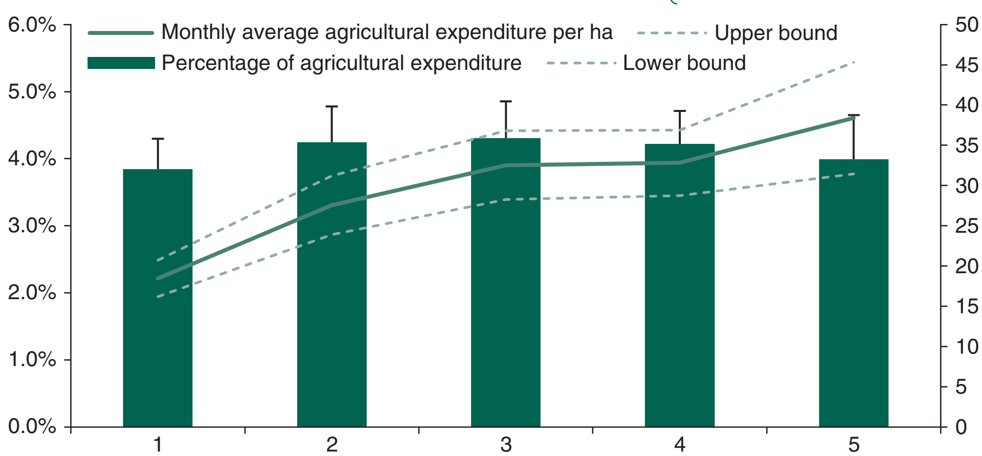
Conversely, the share of agricultural income (see figure 4.9), on average, represents only 14.7 percent of total household income in rural areas. This share varies from almost 10 percent in the poorest households to 18 percent in the wealthiest ones. At the same time, the agricultural income per ha earned by rural households

FIGURE 4.7. SHARE OF EMPLOYED POPULATION IN RURAL AREAS BY SECTOR AND CONSUMPTION DECILE, 2012



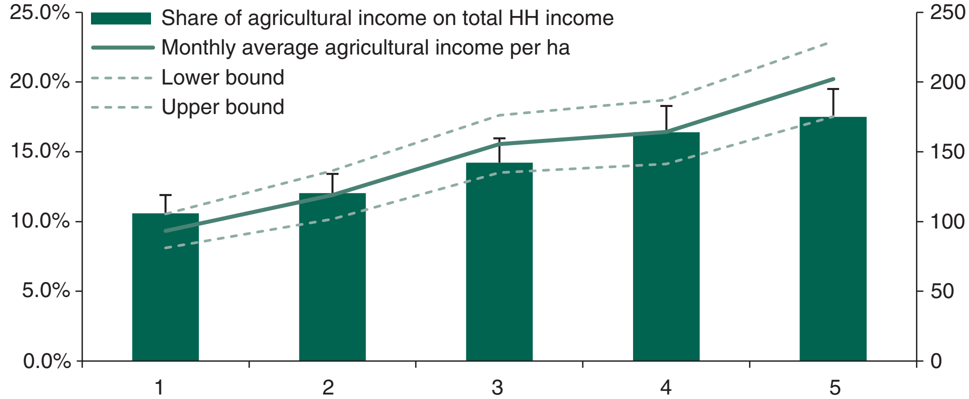
Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.8. SHARE OF AGRICULTURAL EXPENDITURES IN TOTAL HOUSEHOLD EXPENDITURES AND AVERAGE AGRICULTURAL MONTHLY EXPENDITURES PER HECTARE, BY CONSUMPTION QUINTILE, 2012



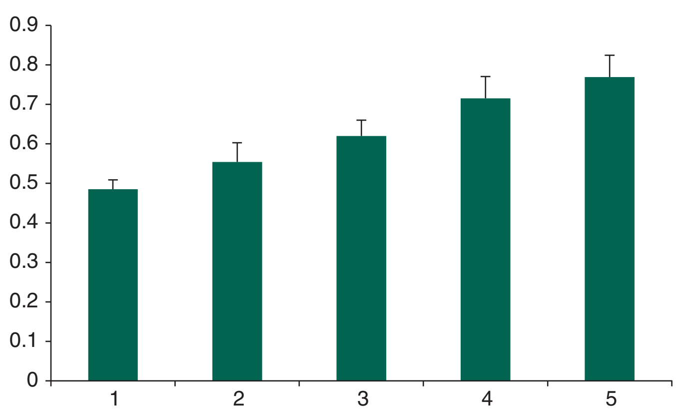
Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.9. SHARE OF AGRICULTURAL INCOME IN TOTAL HOUSEHOLD INCOME AND AVERAGE AGRICULTURAL MONTHLY AGRICULTURAL INCOME PER HECTARE, BY CONSUMPTION QUINTILE, 2012



Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.10. AVERAGE SIZE OF AGRICULTURAL HOLDINGS IN RURAL AREAS, BY CONSUMPTION QUINTILE, 2012

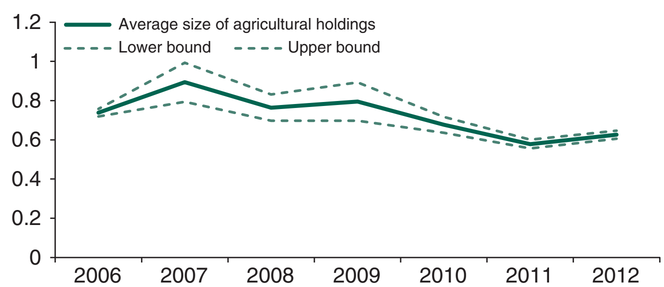


Source: World Bank Staff calculations using Integrated Household Survey data.

increases with wealth. The average income per ha earned in the lowest quintile of consumption is almost GEL 100, whereas the income per ha in the highest quintile reaches almost GEL 200.

These differences are observed despite the fact that the total agricultural land held by farm households is, in general, very small. (See figures 4.10 and 4.11.) In 2012, the

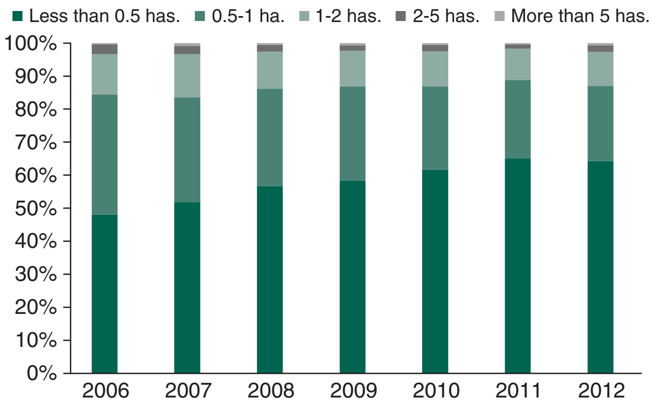
FIGURE 4.11. AVERAGE SIZE OF AGRICULTURAL HOLDINGS IN RURAL AREAS, 2006–12



Source: World Bank Staff calculations using Integrated Household Survey data.

average agricultural area size was 0.62 ha, and it varied from 0.48 ha at the lowest quintile to 0.76 ha at the highest quintile of consumption. Moreover, there is some evidence of agricultural land fragmentation. The average size of agricultural land has decreased significantly since 2006, the proportion of households with less than 0.5 ha has increased significantly, and at the same time the share of households with agricultural land between 0.5 and 1 ha was reduced between 2006 and 2012 (figure 4.12) Given these findings, it is necessary to investigate the consequences of land fragmentation on the provision of ecosystem services in rural Georgia.

FIGURE 4.12. SHARE OF HOUSEHOLDS BY AREA OF AGRICULTURAL LAND, 2006–12



Source: World Bank Staff calculations using Integrated Household Survey data.

It is also possible to analyze the relationship between poverty and the use of solid fuel for household energy. The impacts of solid fuel use are twofold: indoor air pollution affecting health and a high pressure on forests that reduces their capacity to capture carbon. The consequences related to land erosion are linked to clear cuts.

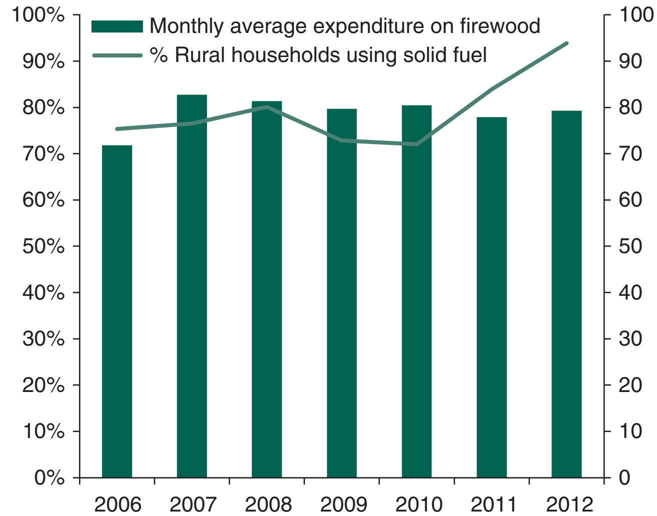
Solid fuel is still a commonly used source of energy in rural Georgia. As shown in figure 4.13, according to the Integrated Household Survey 79 percent of households in rural areas use solid fuel for heating and cooking, a figure that has remained relatively constant since 2006. However, the average monthly expenditure on purchases of firewood among those who had positive expenditures has increased slightly in the same period, from GEL 72.5 per month to GEL 88.9 per month (GEL of 2005). Also, the average monthly harvest of wood for solid fuel among those that harvested remained constant at approximately 1 m^3 a month.

Finally, in 2012 the share of households using solid fuel at home increased slightly with wealth. (See figure 4.14.) At the same time, the amount spent on solid fuel also increased with wealth in 2012, from GEL 58 per month on average for those using solid fuel in the lowest quintile to GEL 113 per month on average for households at the highest quintile.

POVERTY AND NATURAL DISASTERS: A SIMULATION APPROACH

Given the lack of data on the relationship between poverty and the environment, the study uses simulation methods to assess the effect of environmental degradation on poverty. Nevertheless, most of the problems analyzed in the CEA have their origin at the individual or household level, with the exception of natural disasters. Thus, using the results of a macroeconomic process to simulate effects at the microlevel would be inappropriate, at least for the analysis of the effects of air pollution, land degradation, and forest degradation. It is imperative, however, to obtain the data and conduct separate studies that allow a thorough assessment of the impact of these problems on welfare, given their importance in Georgia. In this section, the results from the CGE model will be used to simulate the effect of natural disasters on poverty.

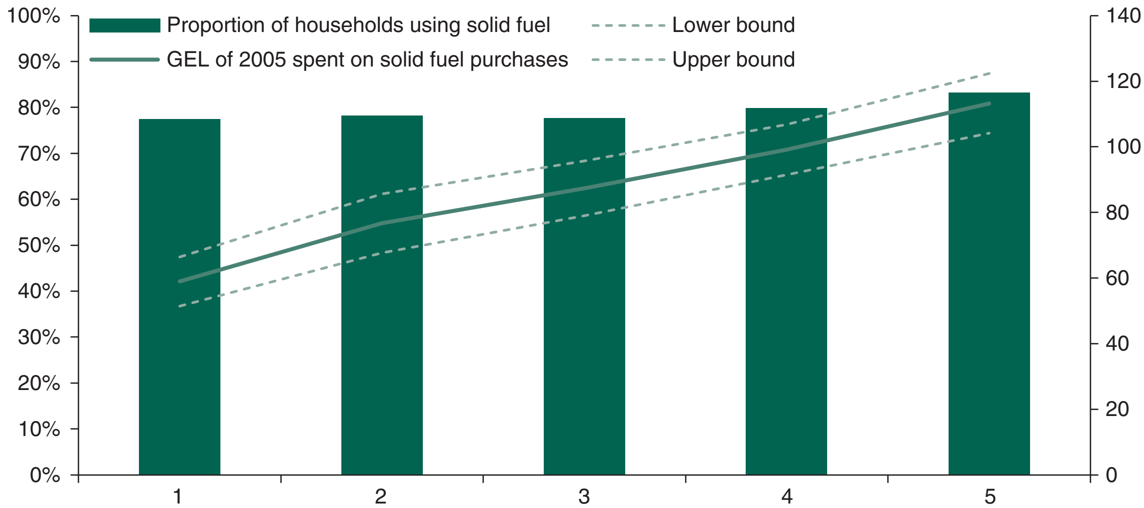
FIGURE 4.13. PERCENTAGE OF HOUSEHOLDS USING SOLID FUEL AND AVERAGE MONTHLY EXPENDITURES ON FIREWOOD PURCHASES, 2006–12



Source: World Bank Staff calculations using Integrated Household Survey data.

The simulation assumes a macroeconomic shock that is transmitted through different microeconomic channels to households. From the macroeconomic side, the change in GDP attributable to the possibility of a natural disaster that affects productivity, especially in agriculture, is simulated using the CGE model. From the microeconomic side, we assume that the effects of the natural disaster are transmitted to households through employment, wages and revenues. In that sense, it is

FIGURE 4.14. PERCENTAGE OF HOUSEHOLDS USING SOLID FUEL AND AVERAGE MONTHLY EXPENDITURES ON FIREWOOD PURCHASES, BY CONSUMPTION QUINTILE, 2012



Source: World Bank Staff using Integrated Household Survey data.

necessary to simulate the participation of the household members in three different economic sectors: agriculture, services and industry, as well as the income generated in the household. Please refer to appendix B for details on the methodology.

The advantages of using microsimulation methods for poverty estimation are that it is possible to simulate the effects of macroeconomic shocks on the entire distribution of income and consumption. This method allows for the identification of impacts in different economic sectors of employment and therefore different groups of the population.

Two scenarios that include the effect of natural disasters on agricultural land crops as well as on infrastructure were simulated, as described in the chapter. The Reference Scenario, with no simulations of the effects of natural disasters on the economy, is also considered (Baseline). Results from the simulation of the two scenarios are presented in table 4.6.

The results show that the cost of a major natural disaster will increase the poverty rate in Georgia by almost 0.2 percentage points in Scenario 1 and by 0.6 percentage points

TABLE 4.6. BASELINE AND SIMULATIONS OF POVERTY RESULTING FROM NATURAL DISASTERS IN GEORGIA

Variable	Baseline 2012	Scenario 1	Scenario 2
Poverty rate	14.8	15.0	15.4
% Poor in:			
Urban	10.4	10.5	10.8
Rural	18.7	19.1	19.6
Average monthly income per capita:			
Georgia	182.6	180.3	178.0
Urban	206.8	204.4	202.2
Rural	160.4	158.0	155.8
% Labor force in:			
Agriculture	52.0	52.9	53.0
Industry	10.1	9.7	9.7
Services	37.8	37.4	37.4
% Poor in:			
Agriculture	70.9	72.9	73.0
Industry	9.9	8.7	8.8
Services	19.2	18.2	18.3

Source: World Bank staff calculations using Integrated Household Survey data.

in Scenario 2. The results reflect the change in earnings caused by the additional cost of natural disasters. The small change in the poverty rate is expected, given the size of the additional cost to the economy caused by natural disasters. However, rural households are the most affected by the shock: the poverty rate increases in rural areas from 18.7 percent to 19.1 percent in Scenario 1 and to 19.6 percent in Scenario 2. Even though the simulation allows reallocation of workers among sectors, the size of the shock does not encourage people to move. Nevertheless, the share of the poor population in each sector increases.

The total number of new poor individuals as a result of natural disasters is 10,564 in Scenario 1 and 24,138 in Scenario 2. About 77 percent of these individuals are in rural areas in Scenario 1 and 75 percent in Scenario 2. Also, the poverty gap, which measures the additional consumption that the poor need to reach the poverty line, increased 1.7 percent and 6.3 percent in Scenarios 1 and 2, respectively. With this measure, it is possible to calculate the total transfers the new poor would need in order to reach the poverty line. In Scenario 1, the new poor would have to receive GEL 7,877, whereas in Scenario 2 this amount increases to GEL 109,010 in order to change the poverty status of the new poor.

In addition, some interesting features come up when analyzing the characteristics of the poor and the population at risk of poverty ("new poor"), as shown in table 4.7. Most who become poor because of the damages resulting from the natural disaster in Scenario 1 come from rural areas (72.1 percent). This number is significantly different from the percentage of people from rural areas that are not poor on the Baseline and Scenario 1. Also, the average income per capita of the new poor is statistically higher to the income per capita of those that remain poor after the natural disaster, and lower to the income per capita of those that never become poor. In addition, the new poor tend to show a higher proportion of people without formal education, in comparison with those that have remained poor. Moreover, the population at risk of poverty is for the most part employed in agriculture. Similar differences are found in table 4.8 when Scenario 2 is considered.

According to the results of the simulations, natural disasters will affect the population along the entire income distribution. As shown in figure 4.15, most households faced a reduction in income, and that proportion is almost constant along the wealth distribution. In all quintiles, between 84 percent and 87 percent of all households faced a reduction of income in Scenario 1, and between 89 percent and 94 percent in Scenario 2. However, some households face an increase in income, given the changes in the different economic sectors. These proportions are between 12 percent and 16 percent for all quintiles in Scenario 1, and between 6 percent and 10 percent in Scenario 2.

It is interesting to show that both the population in the lowest and top quintiles suffered the largest reduction of income and consumption. Table 4.8 shows the average income and consumption per capita for the five quintile groups based on consumption expenditures. The per capita household income for the lowest quintile decreases almost 1.4 percent in Scenario 1 and 3 percent in Scenario 2, and the highest quintile, decreases 1.7 percent and 2.7 percent in Scenarios 1 and 2, respectively. Moreover, the shared prosperity indicator, which measures the growth of per capita consumption of the Bottom 40 (lowest two quintiles), is −0.68 percent in Scenario 1 and −2.1 in Scenario 2, whereas the per capita consumption of the Top 60 (top three quintiles) is only −0.62 percent in Scenario 1 and −1.77 percent in Scenario 2.

The effect of a natural disaster on consumption along the distribution can be easily shown using a Growth Incidence Curve (GIC), as shown in figure 4.16. The negative effect of the natural disaster on per capita consumption can be observed in the two scenarios. However, there is not a clear pattern in Scenario 1: people located at the lower part of the distribution suffered in a very similar way as those located at the top. Conversely, in Scenario 2, the effect is much stronger for everyone, but at, the same time, it is clear that the most affected by the natural disaster are those located at the bottom of the distribution.

Moreover, the total compensation that affected households would have to receive in order to take their income to the

TABLE 4.7. PROFILE OF THE POPULATION BASED ON POVERTY STATUS AT BASELINE AND SCENARIO 1

Variable	Poor at Baseline and Simulation	Nonpoor at Baseline, Poor at Simulation	Nonpoor at Baseline and Simulation
Number of people	544,049	10,564	3,147,742
% Rural	63.7	72.1	48.1
% Female	32.7	35.7	34.4
Age of HH head	57.9	58.9	59.7
% Households with HH head out of labor force at Baseline	47.3	40.4	41.4
Average income per capita at Baseline (GEL)	72.15	81.48	202.0
Average nonlabor income per capita at Baseline (GEL)	45.45	49.86	93.87
Education of HH head			
No formal education (% HH)	3.4	14.7	2.0
Primary school (% HH)	5.0	0.0	3.9
Secondary school (% HH)	57.1	56.1	39.8
Technical tertiary school (% HH)	24.7	27.9	23.9
Undergraduate school (% HH)	0.5	0.0	1.0
Graduate school (% HH)	9.2	1.4	29.5
Sector of employment			
Agriculture (%)	71.0	81.1	49.3
Industry (%)	9.8	0.7	10.2
Services (%)	19.2	18.1	40.5

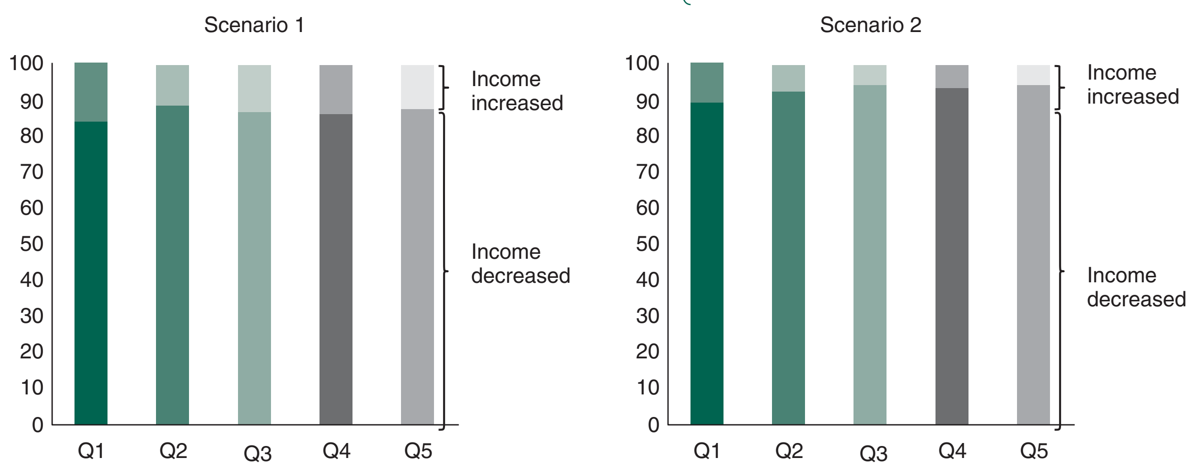
Variable	Poor at Baseline and simulation	Nonpoor at Baseline, poor at simulation	Nonpoor at Baseline and simulation
Number of people	544,846	24,138	3,134,168
% Rural	63.6	72.0	48.0
% Female	32.7	33.0	34.4
Age of HH head	57.9	60.5	59.7
% Households with HH head out of labor force at Baseline	47.3	44.3	41.4
Average income per capita at Baseline (GEL)	72.3	102.0	202.4
Average nonlabor income per capita at Baseline (GEL)	45.4	48.3	94.1
Education of HH head			
No formal education (% HH)	3.5	6.4	2.0
Primary school (% HH)	4.9	5.2	3.8
Secondary school (% HH)	57.1	58.8	39.7
Technical tertiary school (% HH)	24.6	18.4	24.0
Undergraduate school (% HH)	0.5	0.0	1.0
Graduate school (% HH)	9.3	11.2	29.5
Sector of employment			
Agriculture (%)	70.9	72.4	49.2
Industry (%)	9.9	5.6	10.1
Services (%)	19.1	22.0	41.0

TABLE 4.8. BASELINE AND SIMULATIONS OF INCOME AND CONSUMPTION RESULTING FROM NATURAL DISASTERS IN GEORGIA

	Per Capita Household Income (GEL)			Per Capita Household Consumption (GEL)		
Quintile Group	**Baseline 2012**	**Scenario 1**	**Scenario 2**	**Baseline 2012**	**Scenario 1**	**Scenario 2**
1	76.0	75.0	73.7	48.7	48.4	47.6
2	113.9	112.6	111.4	87.7	87.1	85.9
3	158.6	157.4	155.2	127.3	126.4	124.7
4	205.4	203.2	200.4	183.9	182.7	180.4
5	359.5	353.5	349.8	387.1	384.7	380.7

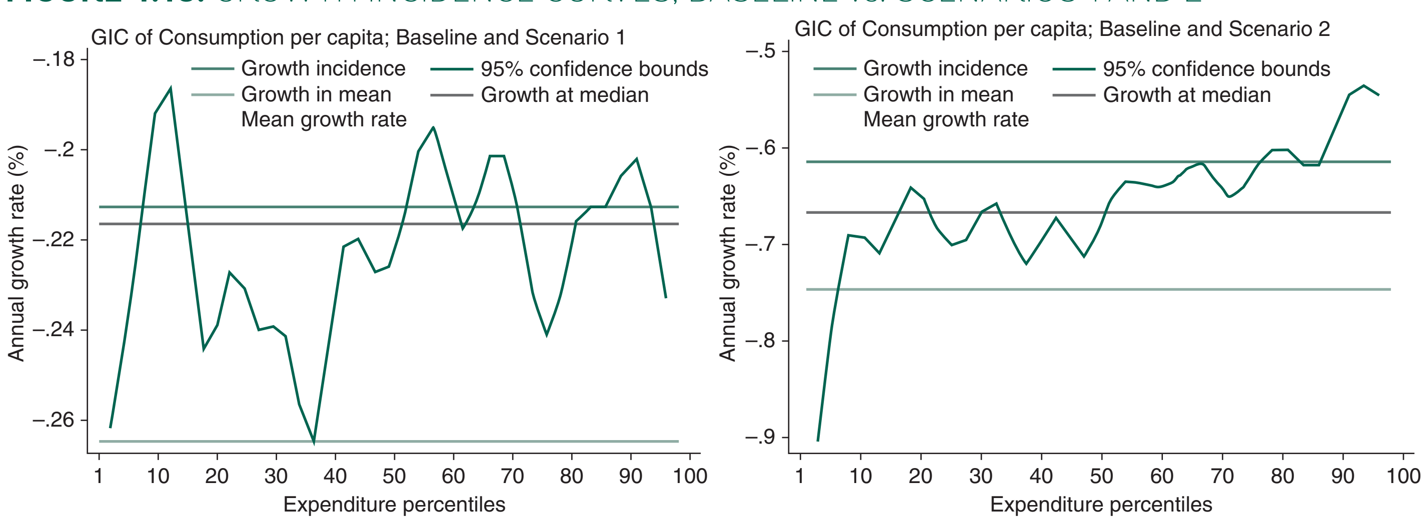
Source: World Bank staff calculations using Integrated Household Survey data.

FIGURE 4.15. PROPORTION OF HOUSEHOLDS BY TYPE OF CHANGE IN INCOME AND CONSUMPTION QUINTILE



Source: World Bank Staff calculations using Integrated Household Survey data.

FIGURE 4.16. GROWTH INCIDENCE CURVES, BASELINE vs. SCENARIOS 1 AND 2



original level is GEL 56.4 million/year and GEL 152.4 million per year in Scenarios 1 and 2, respectively. These numbers can be compared with the annual expenditure the government would have to incur on prevention activities or the provision of insurance directed to reducing the damage of natural disasters.

The results of the simulation presented in the report have to be taken with caution, because the simulations allow full mobility of the workforce among sectors. In reality, there are frictions in labor markets that prevent this from happening. Also, as mentioned, no changes in nonlabor income have been modeled. This is an important issue for Georgia, because more than 30 percent of household income comes from nonlabor sources, such as pensions and government transfers.

Despite the methodological problems that simulations hold, the objective of this exercise is to communicate the idea that it is necessary to invest in prevention of natural disasters, in particular, and in reduction of environmental degradation, in general, to reduce the vulnerability of the less wealthy population. The poor population is the most vulnerable to environmental issues. Thus, having awareness of the environmental problems that the country faces and investing in their solutions is necessary in order to guarantee economic growth that is socially and environmentally sustainable.

CHAPTER FIVE

POLITICAL VISION, POLICY, AND INSTITUTIONS

Georgia is committed to internationally accepted principles of sustainable development as stated in the Socio-economic Development Strategy Georgia 2020. In the international arena, the Georgian leaders declared solidarity with the international community on combating climate change and demonstrated political commitment to mitigating its effects. Georgia's ability to influence climate patterns at the global level is limited. Locally and at the regional level, Georgia is committed to addressing global environmental challenges through adaptation to climate change, acquiring low-carbon technologies and engaging in carbon trade, and managing emissions of greenhouse gases and ozone-depleting substances.

In-country public demand for a clean natural world and a better environment is gradually growing but is not yet well established. A lack of knowledge and awareness of the risks associated with environmental pollution as well as an unwillingness to pay for improvements are hurdles to be overcome. Noticeably, people are inclined not to call for government action toward prevention of environmental risks and instead to contribute to these risks; however, they demand compensation for any damage if and when there are problems in the natural environment.

Since Georgia gained its independence, Georgia's transition has been oriented toward integration with its democratic allies. Integration in the European Union is the cornerstone of Georgia's foreign and internal policy. Most recently, the approximation goals with the EU became clearer with the signing of the Association Agreement on June 27, 2014. The EU harmonization milestones are translated into time-bound action plans for key ministries, including the Ministry of Economy and Sustainable Development and the Ministry of Environment and Natural Resource Protection. The pressure of meeting EU approximation goals is growing, as well as the responsibilities of MENRP to mobilize resources and meet the set targets of environmental quality and governance. The actions assigned to MENRP are among the important thematic areas of the

Association Agreement, requiring significant institutional capacity and resources for planning and implementation.

According to the Association Agreement, the cooperation between the EU and Georgia in the field of the environment aims at preserving, protecting, and improving environmental quality; protecting human health; sustainably utilizing natural resources; dealing with regional or global environmental problems; and integrating environment into other sectors' policies. Specific approximation and harmonization areas with a focus on national environmental legislation include the following:

- » Environmental governance and horizontal issues, including strategic planning, environmental impact assessment, and strategic environmental assessment; education and training; monitoring and environmental information systems; inspection and enforcement; environmental liability; environmental compliance; transboundary cooperation; and public access to environmental information, decision-making processes, and effective administrative and judicial review procedures
- » Air quality
- » Water quality and resource management, including flood risk management, water scarcity, and droughts as well as the marine environment
- » Waste management
- » Industrial pollution and industrial hazards
- » Chemicals' management
- » Nature protection, including forestry and conservation of biological diversity
- » Climate Action

Trade and sustainable development form a separate chapter of the Association Agreement of trade-related Deep and Comprehensive Free Trade Area (DCFTA). The chapter covers the following environmental issues:

- » Multilateral environmental governance and agreements;
- » Biological diversity, including trade in natural resource-based products obtained through a sustainable use of biological resources and contributing to the conservation of biodiversity;
- » Sustainable management of forests and trade in forest products;
- » Trade in fish products.

INTERNATIONAL COMMITMENTS

In 1994, Georgia became a party to the UN Framework Convention on Climate Change. Georgia has also assumed international commitments to join regional and global efforts in improvement of environmental conditions and addressing a variety of environmental challenges including biodiversity loss and biosafety; promotion of landscape protection; desertification; transboundary air pollution; ozone depletion; transformation of wetlands; trade in endangered species; conversation of wildlife, natural habitats, migratory species, and wild animals; protection of human health and the environment from persistent organic pollutants; transportation of hazardous substances; pollution of the Back Sea; radioactive safety. Also, Georgia is a signatory and the Party to the United Nations Economic Commission for Europe (UNECE) Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters (Aarhus Convention) since its adoption in 2001.

INSTITUTIONS

An environmental authority under various titles and with changing mandate has been part of the government structure for more than two decades. The most recent and dramatic restructuring of the environmental line entity occurred in 2012; this removed the function of natural resource management and weakened the role of the Ministry of Environment in natural resource management. However, this change was not long lived, and this vital function was reestablished in the Ministry of Environment and Natural Resource Protection in 2013. The ministry's budget significantly increased.

The MENRP is the primary environmental policy maker and it administers environmental management functions. The ministry acts as a proponent in the environmental legislation process. The most challenging administrative functions of MENRP include environmental permitting and supervision. Also, the National Environment Agency is a legal entity under the Public Law (LEPL) under the MENRP and responsible for issuing licenses for natural resource use (excluding licenses for oil exploration and extraction). The National Forestry Agency (LEPL) is also under the MENRP. The legal basis, human resources, and material means for exercising these functions by the ministry are evolving quickly but not fully in place.

Because of the cross-cutting nature of environmental governance, the MENRP is not the only state entity upon which the national performance depends. Unfortunately, institutional capacity for environmental management remains weak in line ministries and is virtually nonexistent in the regional and municipal administrations. There are no environmental safeguard units in key sectoral ministries such as the Ministry of Economy and Sustainable Development, the Ministry of Energy, the Ministry of Regional Development and Infrastructure, and the Ministry of Agriculture. Interagency coordination and cooperation on environmental matters lacks systemic approach and organization. It is mostly confined to circulation of draft environmental policy and regulatory documents to various line entities for feedback and endorsement, which is a mandatory procedure. Joint management of environmental issues that call for multientity participation and harmonized action remains highly challenging. Problem areas include air quality, integrated coastal zone management, integrated watershed management, and the management of multiple use zones of protected areas.

NATIONAL LEGAL FRAMEWORK REGULATING THE ENVIRONMENT AND NATURAL RESOURCES

The environmental legal framework is well developed in Georgia and covers all key aspects of environmental legislation. Because of the country's vibrant economic development and significant changes in its political setup, the national regulatory framework in general and environmental legislation in particular have been subject to frequent changes, and the process of new lawmaking has also been permanently under way. A wave of amendments aimed at liberalization of environmental legislation and loosening control mechanisms was adopted in 2010–11. Reverse changes occurred shortly afterward, attempting to balance out overly zealous efforts to clear the way for investments at the expense of compromised sustainability.

One highly important set of laws and bylaws regulates environmental licensing and permitting as well as environmental impact assessment. This legislation carries a number of significant mismatches with internationally accepted good practice, including that practiced under the EU. The most important improvements to be introduced toward harmonization of the national legislation with the EU requirements are the introduction of environmental classification of activities based on scope and risk levels and a ruling in strategic environmental assessment of regional and sectoral development programs. A few types of high-risk activities that are not subject to environmental assessment at present will become subject to this procedure—exploratory and commercial mining being one of these. A new Forest Law is being developed to reflect the guiding policy approach provided in the recently adopted National Forestry Program. A Water Resource Management Law, also currently in the works, is expected to provide the basis for sustainable watershed management. The Waste Code has been in effect since January 2015. It formulates the responsibilities of various institutions and entities for management of solid waste and would need major strengthening of national and local capacity for implementation and monitoring.

The absence or inadequacy of bylaws and regulations characterizes the shortcoming of the national environmental regulatory framework. Many environmental norms and standards as well as methodological guidelines for their establishment were inherited from the Soviet Union. They lack feasibility and flexibility, sometimes not being realistic. There are a series of regulations awaiting revisions in order to align with good international practices and national targets of environmental quality. The most pressing include the methodology for monitoring ambient air quality and establishing optimal acceptable levels of pollution, norms regulating discharge of various types of pollutants into surface water bodies, and—in the long run—norms for addressing nonpoint sources of nutrient pollution from agriculture required for the EU approximation and for sustaining the quality of the ambient environment.

The national aspiration to mitigate climate change and a commitment to adherence to the principles of green development, energy efficiency, and low emissions—although among the national goals at the policy level—are not supported by regulatory instruments.

POLICY DEVELOPMENT

The Socio-economic Development Strategy Georgia 2020 was adopted by the government on June 17, 2014. This document sets forth three main principles for achieving the 2020 goals: boosting productive sectors of economy, fostering inclusive growth and social equity, and ensuring environmental safety and sustainability through the prevention of natural disasters and the rational use of natural resources. Policy actions provided for achieving the goals are fully integrated in the strategy. For instance, technological progress and innovation will be fueled by facilitating the introduction of environment-friendly modern technologies and investment into a "green" economy. Incorporating results of environmental impact assessments and applying mitigation measures are established as important aspects of infrastructure development, including facilities for energy generation and transmission. The strategic objective of improving municipal service provision includes development of water supply, sanitation, and solid waste management systems so that their operation is compliant with EU environmental and technical standards.

The second National Environmental Action Plan, covering 2012–16 (NEAP-2), covers 11 thematic issues: water resources, ambient air quality, waste and chemicals management, the Black Sea, biodiversity and protected areas, forestry, land resources, mineral resources and groundwater, natural disasters/hazards, nuclear and radiation safety, and climate change. The NEAP-2 also addresses cross-cutting issues such as environmental impact assessment and permitting, enforcement, monitoring, and environmental education and public awareness. It elaborates the issues and causes faced in each problem area, identifies stakeholders, lists important actions taken to date, and assesses the regulatory framework. Most important, the NEAP-2 lays out actions to be undertaken to address outstanding issues, names entities responsible for implementing these actions, analyzes expected risks, and establishes success indicators. The NEAP-2 does not provide cost estimates of the actions but rather ranks them as "more" or "less" expensive. Consequently, the NEAP-2 implementation was not budgeted by the government. Parts of the NEAP-2 were picked up by the Basic Data and Directions documents, whereas for a number of other actions, grant funding was provided by donor organizations.

BDD is a composite document representing the state's annual budget plans as well as Medium-Term Expenditure Framework, which reflects the government's medium-term strategic priorities and targeted outcomes. BDDs for 2013–16 and 2014–17 both show increased government acknowledgment of environmental and sustainability issues. The 2014–17 BDD names protection of the environment and rational use of natural resources among established priorities and commits to serve the goal of gradually attaining environmental standards adhered to in the EU space or established by international treaties. More specifically, the 2014–17 BDD is designed to support improvement of the legal and regulatory framework for environmental management and to invest in:

- » Management of forests, water and land resources, protected areas and biodiversity, and waste
- » Improvement of ambient air quality
- » Prevention of industrial accidents and natural disasters
- » Lowering emissions and adaptation to climate change
- » Capacity increase for environmental inspection and control
- » Environmental education and awareness raising

Other sectoral policy documents include the National Forest Concept (adopted in December 2013), the National Biodiversity Strategy and Action Plan for 2014–20 (adopted in May 2014), the Second National Action Program to Combat Desertification 2015–2022, and an Integrated Water Resource Management Plan and National Waste Management Strategy and Action Plan currently under development.

BUDGET POLICIES AND ENVIRONMENTAL FINANCING

RESOURCES AVAILABLE AND BUDGET CAPACITY

The review of public environmental expenditure aims to present the current status of Georgia's public resource allocation and spending patterns related to the funds

TABLE 5.1. ENVIRONMENTAL EXPENDITURE, TOTAL GOVERNMENT EXPENDITURE, AND GDP IN GEORGIA, 2009–13 (GEL, MILLIONS)

Year	*2009*	*2010*	*2011*	*2012*	*2013*
GDP	17,985.95	20,743.36	24,343.99	26,167.28	26,824.93
Environmental expenditure (EE)	36.24	28.56	25.64	21.85	25.85
*Total government expenditure**	6,274.27	6,486.73	6,862.92	7,261.63	7,313.25
EE as % of GDP	0.20%	0.13%	0.10%	0.08%	0.09%
EE as % of total government expenditure	0.58%	0.44%	0.37%	0.30%	0.35%

Source: National Statistics Office of Georgia and Ministry of Finance.
Note: For 2011 and 2012 public environmental expenditure includes expenditures by MENRP and Ministry of Energy.
* "Increase in financial assets" and "decrease in liabilities" are not included.

allocated to environmental protection in the public budget system. It examines the extent to which the present budget system meets strategic objectives based on the data available. Public environmental expenditures are analyzed by spending agency (MENRP, Ministry of Energy, other institutions), by type of expenditure (current, capital), and by environment domain (air, water, waste, and so on).

Public funds for the environment in Georgia come from the central government, municipalities, donors and publicly owned enterprises (waste and water management companies), and the Agency for Nature Protection. The MENRP is the main institution financed through the state budget. The Ministry of Energy, the Ministry of Regional Development and Infrastructure (mainly through the United Water Supply Company LEPL, and Solid Waste Management Company LEPL), the Ministry of Agriculture, and the Ministry of Labor, Health, and Social Affairs (through the National Center for Disease Control and Public Health LEPL) are also among the recipients of public funds for environmental protection. The municipalities receiving the direct transfers from state budget are responsible for the municipal waste management at regional level. Tracking down expenditures outside the core agencies of the Ministry of Environment and Ministry of Energy is a major problem. Thus, in most cases expenditures by core environmental agencies just noted serve as a proxy for public environmental expenditures.

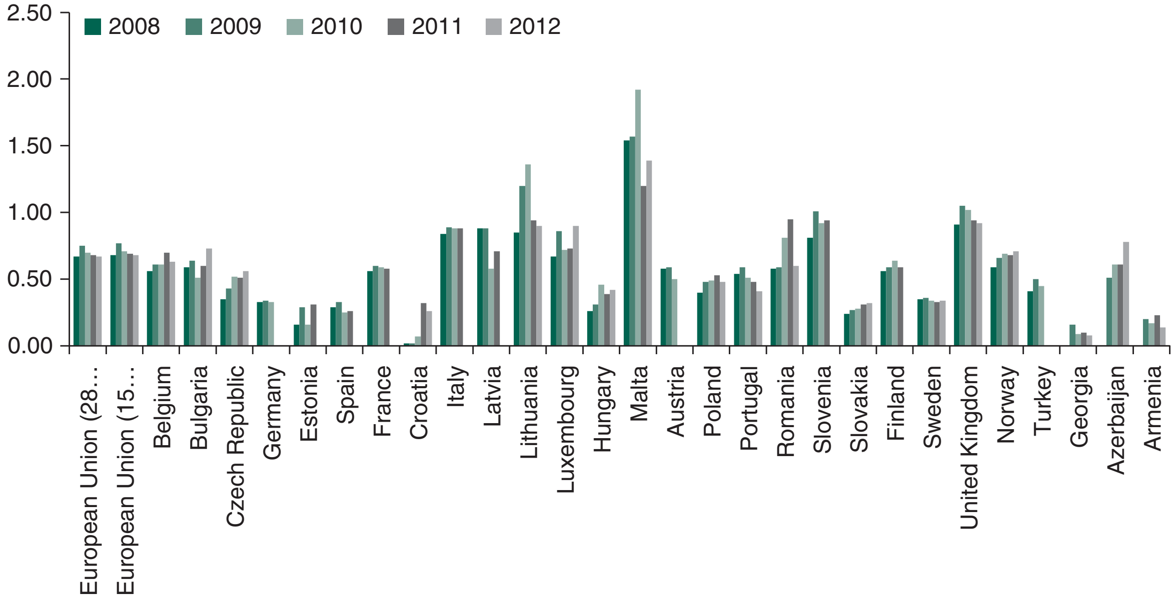
A review of the public environmental expenditure by the main ministries responsible for environmental protection during the period 2009–13 shows that the total spending amounted to an average of 0.37 percent of total government spending. (See table 5.1.) Despite the fact that since 2012 the government Program has defined environmental protection as one of its priorities, and despite the MTEF BDD also declaring environmental protection as one of the priorities, the budget/expenditure for 2011–13 decreased compared with 2009–10.

The Georgian Environmental Protection Law is the main legislation governing environmental issues. It does not define "environmental expenditure" as such, but the Georgian State Budget System considers a separate account (Code 705) for "environmental protection" within the classification of the expenditure by the functions of government (based on the *Government Finance Statistics Manual 2001—Classification of Outlays by Functions of Government*), and the environmental protection expenditures are divided into six broad groups that correspond to the Classification of Functions of Government (a Eurostat functional classification): waste management, wastewater management, pollution abatement, protection of biodiversity and landscape, R&D environmental protection, environmental protection not elsewhere classified (n.e.c.).[14]

This classification makes it possible to compare Georgia to other countries, particularly those in Europe. Compared with most of the countries in Europe, Georgia spends considerably less on the environment as a percentage of GDP (0.08 percent in 2012). (See figure 5.1.) It should be noted, though, that the difference would be smaller if

[14] Starting in 2013, "forestry" expenditure was included under the "protection of biodiversity and landscape," but in 2009–12 it was classified under "economic affairs" with a separate code (70422).

FIGURE 5.1. ENVIRONMENTAL PROTECTION EXPENDITURES IN EUROPE, 2008–12



Source: Eurostat.

spending of all budget users were included and if forestry were included in the "environmental protection" category in 2008–12.

When compared with immediate neighbors, Georgia's environmental expenditures are somewhat comparable to those in Armenia but substantially lower than in Azerbaijan (as percentage of GDP but also in absolute terms). (See table 5.2.)

TABLE 5.2. ENVIRONMENTAL EXPENDITURE (% OF GDP)

	2011	2012	2013
Armenia	0.23	0.14	0.10
Azerbaijan	0.61	0.78	0.69
Georgia	0.10	0.08	0.09

Source: www.mof.gov.ge; www.armstat.am; www.stat.gov.az.

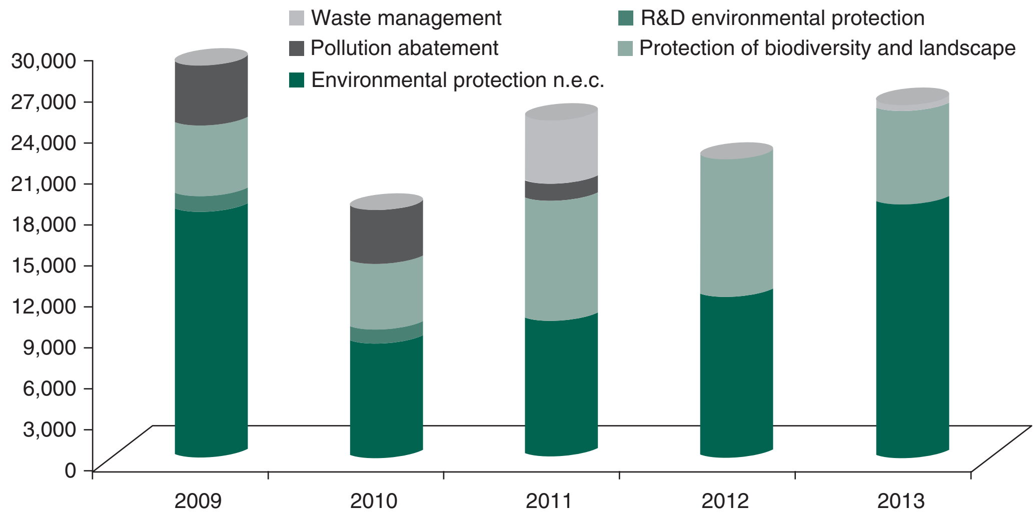
The ratio between environmental protection expenditures and GDP provides an indication of the importance of environmental protection relative to the overall economic activity. Overall, among the EU-28 countries this ratio stood at 1.14 percent of GDP in 2012, compared with 0.67 percent for the public sector and 0.39 percent for industry. The weight of environmental protection expenditure (in relation to GDP) of industry rose by 0.16 percentage points between 2002 and 2012 with the gradual enforcement of environmental regulations harmonized with the EU.

TYPE OF EXPENDITURES, TRENDS, AND DYNAMICS

Despite the fact that the MTEF BDD provides possibilities, and that sometimes environmental issues are reflected in the narrative part of the different sectors' policies, the related allocation of funding is not clearly reflected under the relevant ministries/institutions' budgets. Thus, the allocation of the funding and related environmental spending of the responsible institutions is not clearly reflected in the state budget (not considered under the functional classification "environmental protection"). This makes it difficult to compare the budget expenditure figures of the functional classification "environmental protection" and the ministries/institutions' budget/expenditure figures related to environmental spending.

In addition, although there is a clear description of the domains within the functional classification "environmental protection," the allocation of funds by the relevant domain is not always taken into account, and most of the funds are included under the subcategory "705 6

FIGURE 5.2. PUBLIC ENVIRONMENTAL EXPENDITURES BY DOMAIN (GEL'000)



Source: Ministry of Finance of Georgia, Ministry of Environment Protection of Georgia.
Note: As of 2013, forestry expenditures were classified under the domain "protection of biodiversity and landscape." In previous years, they were classified separately (Code 704 222). 2012–13 expenditure of the Legal Entity of Public Law (LEPL) the National Environmental Agency, which is responsible for implementation of pollution monitoring, is included under the "environmental protection n.e.c."

Environmental protection n.e.c."[15] The official expenditure reports of the state treasury reflect just the total figures (without a breakdown by the subcategories or domains). Thus, the existing classification by domain does not reflect the actual distribution of the budget/expenditures within the domain. This raises the issue of allocative efficiency of the environmental spending. Figure 5.2 presents MENRP's expenditures by domain.

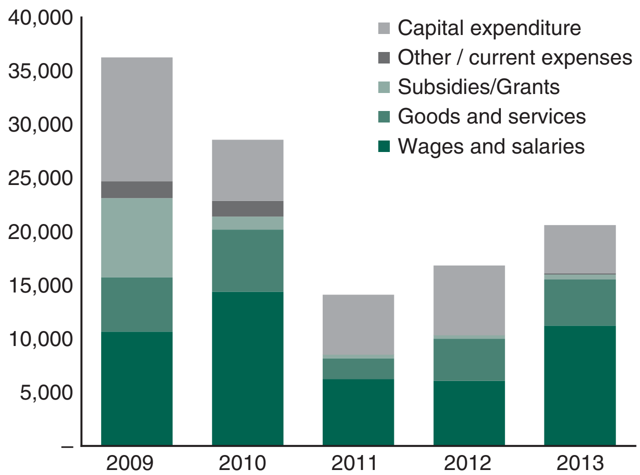
Expenditures on the protection of biodiversity and landscape, including forestry, have been more or less stable. Waste management has seen a decline over the past two years, but this is most likely because part of the expenditures for waste management have been channeled through other institutions—for example, the Rustavi Solid Waste Project financed by the European Bank for Reconstruction and Development was implemented by the Ministry of Finance through the Municipal Development Fund LEPL. Conversely, pollution abatement is most likely severely underfunded. It has disappeared as a category in itself from the expenditures of 2012–13 and was negligible in 2011. Funding of the LEPL National Environmental Agency, which is responsible for pollution monitoring, was included in the category "environmental protection n.e.c."

The Agency of Protected Areas (APA), being a legal entity that operates under the state control from the MENRP, generates its own revenues (while receiving basic funding from the state budget). APA, by mandate, has the opportunity to generate revenues from public visitation to protected areas. Currently, APA reinvests most of these revenues into protected areas—adding/upgrading infrastructure, for instance, or procuring vehicles/horses for rangers.

For the purposes of comparison, it should be noted that waste management and wastewater treatment are typically the two main domains for public sector expenditure in most EU member states. Exceptions to this include Spain (where the public sector directed its expenditure toward other domains, such as biodiversity and landscape protection, protection from radiation, R&D, and other environmental protection activities) and Cyprus, Denmark, and France (where more than 60 percent of expenditures [in Denmark more than 90 percent] were in the miscellaneous category, covering protection and remediation of soil, groundwater and surface water, noise and vibration

[15] According to GFS-2001 International Classification, *environmental protection n.e.c.* is defined as the "administration, management, regulation, supervision, operation and support of activities such as formulation, administration, coordination and monitoring of overall policies, plans, programs, budgets for the promotion of environmental protection; preparation and enforcement of legislation and standards for provision of environmental services; production and dissemination of general information, technical documentation and statistics of environmental protection."

FIGURE 5.3. EXPENDITURES OF THE MENRP/MOEP BY SECTOR (GEL '000)



Source: MENRP.

abatement, protection of biodiversity and landscapes, protection against radiation, R&D, general environmental administration and management, education, training, and information relating to the environment, as well as activities leading to indivisible expenditures and activities not elsewhere classified).

As noted, it is quite disturbing that in the past few years expenditures tend to be lumped under one category—environmental protection n.e.c. This forbids both tracking and analysis of specific expenditures. Keeping to clearly defined categories would be a good place to start. Second, there is no evidence that budget allocation is based on policy priorities. Air pollution (both indoor and ambient) has major societal cost implications (see the next chapter on COED), although there seems to be very little funding provided for pollution abatement purposes. Aligning environmental expenditures with policy priorities is a key for achieving sustainable outcomes.

As shown in figure 5.3, recurrent expenditures account for a significant portion of MENRP's spending, on average above 70 percent between 2009 and 2013. Of particular concern are the negligible amounts for current expenses, indicating possible significant underfunding of the MENRP program's operation and maintenance funding.

Considering Georgia's aspirations for joining the EU and the obligations signed in the Association Agreement, it

TABLE 5.3. BUDGET EXECUTION RATES FOR MENRP/MOEP, 2009–13 (%)

	2009	2010	2011	2012	2013
Wages and salaries	99.4	99.4	99.6	98.3	101.5
Goods and services	88.2	87.9	89.7	84.9	85.4
Subsidies/grants	94.9	74.1	74.6	59.5	64.2
Other/current expenses	97.4	79.9	58.4	67.1	89.6
Capital expenditure	95.1	96.7	82.8	76.3	49.9

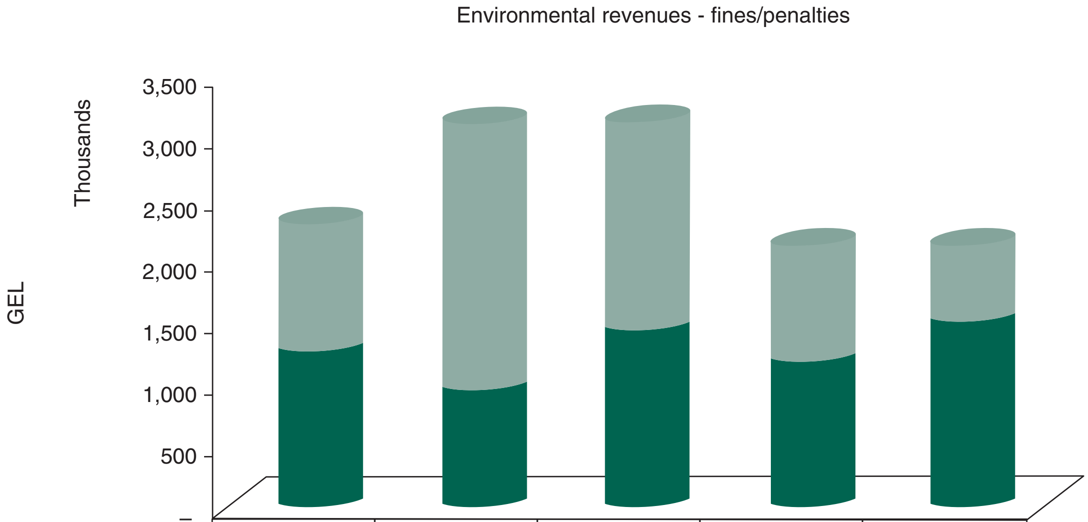
Source: Ministry of Finance.

would be safe to expect that in the future the composition of expenditures by economic category will have to shift toward a balanced investment, planning and factoring in the recurrent costs. This includes measures for cost recovery of municipal services, including wastewater treatment and solid waste. Typically in the new member states, the relative weight of investment for these services is substantially higher, up front, reflecting the capital expenditure on fixed assets required to meet EU environmental legislation.

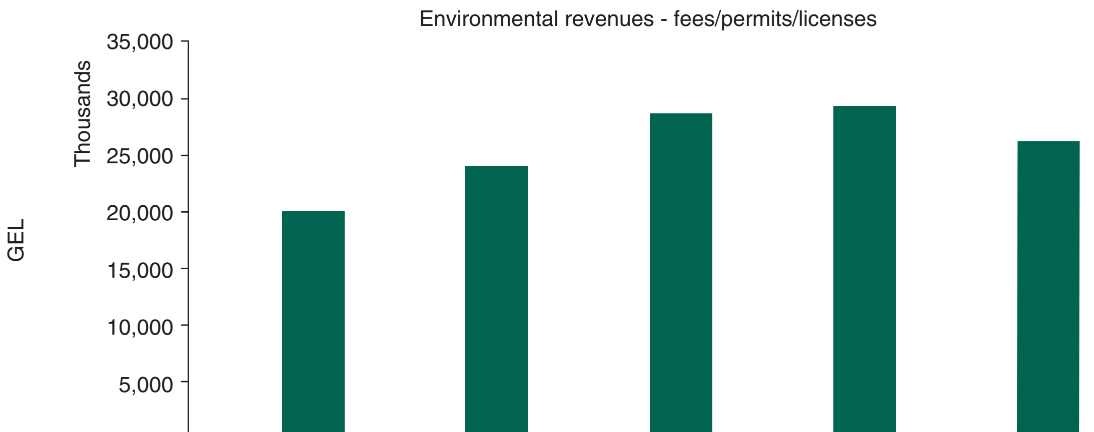
Appropriations of an environmental budget have been dropping slightly but consistently. Even in the situation of a tight resource envelope, environmental budgets experienced underruns over the past years, with the execution rate dropping from about 95 percent in 2009 to 79 percent in 2013. The execution of budgeted environmental expenditures has been quite consistent and stable when it comes to personnel expenditures (wages and salaries) and goods and services. It has been much more volatile in relation to capital expenditures. MENRP's execution performance related to capital and development expenditures is fairly weak.

Implementation of capital projects has been steadily slowing down since 2010, and it fell sharply in 2013, primarily because of delays with implementation of several projects. Examples include the Natura conservation program South Caucasus Georgia; establishment of Javakheti National Park (KfW), which budgeted GEL 2,681,000 versus actual expenditure of GEL 664,386; the Support Program for Protected Areas in the Caucasus Georgia (Ecoregional Program Georgia, Phase III) (KfW), which budgeted GEL 1,165,000 versus no actual expenditure; and the development of Okatse Canyon's tourism infrastructure, which budgeted GEL 1,000,000 versus no actual expenditure. This indicates that there is vast

FIGURE 5.4. BUDGET REVENUES FROM ENVIRONMENTAL FINES, PENALTIES, FEES, PERMITS, AND LICENSES



	2009	2010	2011	2012	2013
Central	1,040,000	2,127,000	1,696,000	928,000	575,000
Municipal	1,275,000	983,000	1,441,000	1,187,000	1,545,000



	2009	2010	2011	2012	2013
Central	258,000	144,000	183,000	89,000	186,000
Municipal	20,067,000	24,086,000	28,534,000	29,411,000	26,226,000

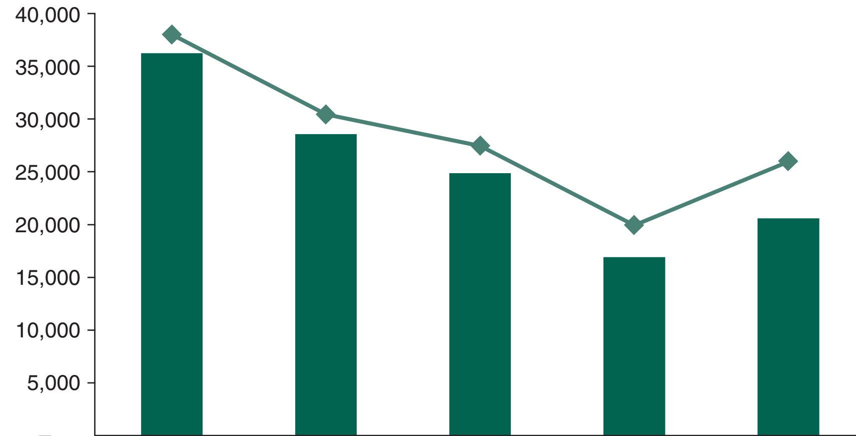
Source: Ministry of Finance.

opportunity for improvements in project implementation capacity including for procurement and contract management, and thus the overall budget implementation and the effective use of a capital investment program.

In the postcrisis period 2010–12, the government of Georgia was committed to fiscal consolidation to restore macroeconomic buffers that were used up during the crisis (World Bank 2014c). In the medium term, fiscal stability will mostly depend on expenditure consolidation and improvements in taxation at the local level. Experience from other countries suggests that increasing the level of environmental fines and penalties and their effective collection could raise the nontax revenues. However, it is more important to use the fines and fees to stimulate behavioral change of polluters.

Georgia collects environment-based revenues for administrative violations in the field of environmental protection and natural resources and as compensation for the environmental damage—state compensation for damages. (See figure 5.4.)

FIGURE 5.5. ENVIRONMENTAL BUDGET VERSUS ENVIRONMENTAL EXPENDITURE (GEL '000)



	2009	2010	2011	2012	2013
Environmental expenditure	36,255,810	28,570,593	24,859,272	16,898,937	20,601,222
Environmental budget	38,033,600	30,441,200	27,467,167	19,940,600	25,975,000

Source: National Statistics and Ministry of Finance.

The natural resources fees are collected in the general state budget from the central and municipal levels. The fees are divided into the following groups:

» *Natural resources user fees*—for the use of soil; for the use of state forest timber resources; for nontimber forest resources extracted from the environment and the use of wood products; for the use of water resources; for hunting; for extraction of migratory birds; for use of other nonclassified natural resources.

» *Licensing fees*—for fishing and hunting permits; for environmental impact; for State Ecological Expertise of MENRP; for forestry or timber harvesting and hunting economy/licenses for mineral exploration and use of underground resources; for the use of wild fauna and flora; for restoration of green plantation; for endangered flora and fauna species; and for export, import, reexport, and extraction from the sea.

The nontax revenue in the budget for 2012 accounts for 2 percent of GDP and accrues from local fees and fines, the sale of goods and services, rents, and dividends. Currently, the data are insufficient to support an assessment of the revenue performance from nature-based fees and fines. Going forward, there are growing uncertainties about how Georgia will meet the capital and recurrent cost requirements for building public environmental infrastructure and environmental protection in order to support the implementation of environmental regulations that would be harmonized with EU environmental *acquis*.

To summarize, the public environmental expenditure declined steadily until 2012. Although this trend was slightly reversed in 2013, given the amount of environmental problems that Georgia has to solve, budget resources fall short of what is needed to combat environmental degradation. The constitutional ban on increasing taxes limits the introduction of new environment-based tax categories. Local taxes that are not subject to constitutional ban could provide some leverage if they are defined with reference to taxing the negative externalities (Pigovian taxes).[16] Georgia could also consider improving the prioritization and allocative efficiency of public expenditure, using the economic rationale of the Wealth Accounting and the Valuation of Ecosystem Services system, which could help mainstream natural capital accounting in national accounting systems and policy analysis.

INTERNATIONAL FINANCIAL ASSISTANCE

The donors' share of government environmental expenditures, although significant in terms of number of activities and areas covered, is surprisingly modest in terms of actual monetary contribution. See appendix A for the full list of donor-funded projects. Figure 5.6 presents the

[16] These types of taxes are based on an assessment of the motive for setting rates of tax—that is, the extent to which a particular tax rate will reduce the negative externality. Pigovian taxes do not include taxes collected for fiscally motivated reasons.

BOX 5.1. ENVIRONMENTAL TAXES

The UN System of Environmental-Economic Accounting Central Framework lists four broad categories of environmental taxes: energy, transport, pollution, and resources.

Energy Taxes

This category includes taxes on energy products used for both transport and stationary purposes. Taxes on fuel used for transport purposes should be shown as a separate subcategory of energy taxes. Energy products for stationary use include fuel oils, natural gas, coal, and electricity. Taxes on carbon are included under energy taxes rather than under pollution taxes. If they are identifiable, carbon taxes should be reported as a separate subcategory within energy taxes. A special type of carbon tax includes payments for tradable emissions permits.

Transport Taxes

This category includes mainly taxes related to the ownership and use of motor vehicles. Taxes on other transport equipment (for example, planes) and related transport services (for example, duties on charter or scheduled flights) are also included here, as are taxes related to the use of roads. The transport taxes may be "one-off" taxes related to imports or sales of the equipment or recurrent taxes such as an annual road tax. Taxes on petrol, diesel, and other transport fuels are included under energy taxes.

Pollution Taxes

This category includes taxes on measured or estimated emissions to air and water and the generation of solid waste. Taxes on carbon are an exception and are included under energy taxes, as discussed above. Taxes on sulfur are included here.

Resource Taxes

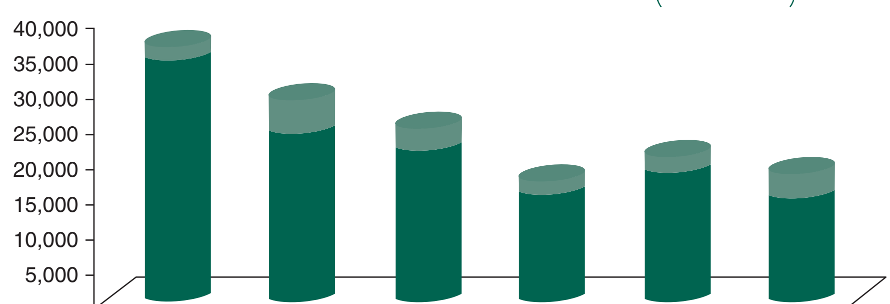
This category typically includes taxes on water abstraction and extraction of raw materials and other resources (for example, sand and gravel). Consistent with the general scope of environmental taxes, payments to the government for the use of land or natural resources are treated as rent and are therefore excluded from resource taxes.

Source: Systems of Environmental-Economic Accounting 2012 Central Framework, UN ST/ESA/STAT/Ser.F/109.

share of donors' contributions in the total government environmental expenditures.

Implementation of a number of donor-funded projects planned for 2009–13 has been delayed and is now planned for 2014–18. It is critical to ensure efficient implementation of those projects, because they would account for the bulk of infrastructure investments. Public financing for environmental projects under MTEF is constrained; thus, prioritizing and increasing budget efficiency will be key. Although this report did not analyze private environmental expenditures, in a number of environmental issues the key interventions have to be addressed by the private sector. As indicated above, there are opportunities to increase the private sector's share of these expenditures and to make the sector pay for externalities through charges and fines.

FIGURE 5.6. DONORS' SHARE OF GOVERNMENT ENVIRONMENTAL EXPENDITURES (GEL'000)



	2009	2010	2011	2012	2013	2014 (Budget)
Donors	1,857,755	4,837,764	3,185,765	1,852,309	2,398,670	3,480,000
Government	34,398,056	23,732,829	21,673,507	15,046,628	18,202,552	14,777,600

Source: Ministry of Environment Protection.

CHAPTER SIX

CARING ABOUT THE ENVIRONMENT AND PEOPLE—THE WAY FORWARD

Nowadays, environmental policies are receiving increasing attention from Georgian policy and decision makers, recognizing that sustainable development is about a profound change of policies that drive systemic transformation of production, consumption, and behavioral patterns. Yet, the transformational effect of these policies needs to focus on environmental quality of life, reducing negative environmental health impacts, strengthening natural resources capital, and promoting innovation. The conclusions summarized in this chapter are derived from the best evidence that could be obtained to describe the underlying environmental concerns, the cost of environmental-health damage, and the impact on economic growth in selected areas. The conclusions are formulated to possibly enhance the analytical underpinning for the effectiveness of the system of environmental management in these areas. The recommendations reflect comments received during the stakeholders' consultations in November 2014. Most of the recommendations are bound to quantitative assessment, whereas others are of a more general nature and are based on qualitative assessment or inputs from external sources used as background comparators because of the scarcity of systemic national data.

On many fronts, current economic policies could demonstrate a clearer commitment to sustainable development. Environmental challenges are likely to undermine the basis of economic growth and sectors such as agriculture and forestry that support vital economic and environmental functions. The central finding is that the annual economic loss from ambient air pollution, household air pollution, lead exposure, agricultural land degradation, deforestation, loss of amenity from untreated solid waste, and natural disasters amounts to GEL 2 billion (US$1.2 billion), or 7.4 percent of the country's GDP (in 2012). This is the mean range obtained between 5.5 and 12.7 percent, although it does not fully reflect the uncertainty in the estimates, which is considerably greater. Compared with other countries where the World Bank has conducted similar studies, the figures are in the high range, although COED valuation methodology has been changing over the years. Given that the largest share of damages expressed in percentage of GDP is caused by ambient air pollution (34 percent) and household air pollution (24 percent), followed by lead exposure (16 percent) and land degradation (14 percent), a strong package of policy measures would be required to address the issues.

The macroeconomic impacts of environmental degradation affect human health and decrease economic opportunities of poor. Unlike other structural changes, the reforms of environmental policies would, therefore, need to be tailored to address specific challenges that cut across various sectors and have broader socioeconomic effects. For example, land degradation as a result of floods, wind erosion, overgrazing, and the progressive loss of vegetation resulted in annual loss of crop production estimated at about US$87 million. About 66 percent of agricultural lands that were eroded or degraded could be potentially abandoned, because land productivity is significantly reduced. This might yield higher poverty rates among populations participating in agriculture. Potential crops that may be destroyed, as result of natural disasters is estimated between 2.29 percent and 2.53 percent of the 2012 yield. Based on the macroeconomic simulations, the expected combined effect from damage to buildings and cropland in the next 50 years could vary between 4.5 percent and 8.29 percent of Georgia's current capital stock.

Environmental degradation and the loss of value caused by poor air quality, untreated waste, loss of land productivity, natural disasters, and associated disease and mortality are not calculated in the standard definition of the GDP. The economic impacts of environmental degradation go beyond annual GDP loss. In Georgia, the decrease of growth rate caused by distributional effects on the economy and welfare associated with ambient air pollution are estimated at approximately 0.48 percent of GDP. The COED points to the elevated risk of suffering pollution-associated illnesses caused by $PM_{2.5}$ exposure, acute respiratory infections in children, cardiopulmonary disease, and lung cancer in adults. The macroeconomic analysis estimates that the main population at risk is urban skilled labor, which includes about 47,360 employees, out of which 1.26 percent might die prematurely as a result of a high level of $PM_{2.5}$. Then the estimated annual GDP loss from the health effects of poor indoor air quality is 0.89 percent, compared with an alternate scenario in which clean fuels would have been used in households for heating.

A CGE model estimates the expected growth loss as a liability on the economy that can surge at any point in the future in the absence of interventions to improve environmental quality or to mitigate disaster risks. At a predicted average annual growth rate for Georgia of 4.55 percent in 2013–16, each year the country would lose 1.36 percentage growth points owing to chronic pollution problems (air pollution and exposure to lead), and an almost equal amount of growth performance is at peril owing to natural hazards; modeling results show that a 50-year disaster event in Georgia could lower its annual growth rate by 1.49 percentage points. Therefore, in 2013–16 Georgia is projected to grow 4.55 percent in the reference scenario that ignores the COED. The average annual growth rate adjusted for the COED is only 3.19 percent (below the projected world growth rate for the same period of 3.62 percent). Based on the modeling results, Georgia's economic performance can further be reduced to 2.94 percent when the risk of a high-intensity disaster event is taken into account.

It would be necessary to adequately weigh the benefits of deregulation against the repercussions on public health. There is a risk that the cost of environmental degradation could fall disproportionately on certain populations, low-income groups, and households and localities that depend on local natural resources. In addition to the toll on children's health and developmental abilities, the estimated annual GDP loss from exposure to lead is 0.89 percent compared with an alternative scenario in which clean fuels would have been used in country households. To address the health risks of high-risk groups, policy interventions such as those aiming to decrease air pollution, enforce quality standards for petrol, control the parameters of market fuels used in all vehicles, reestablish the institutional framework for control of vehicle emissions, and bolster education and awareness are more than necessary.

Poor groups, who lack access to decision-making processes, are most vulnerable to the effects of natural disasters, as they have limited adaptive capacity. Paying particular attention to increasing the adaptive capacity of the Bottom 40 would help reduce the shock effects on the rural economy. The cost of major natural disasters and the economic effects would be transmitted to households through employment, wages, and revenues. The cost of a major natural disaster would mainly affect rural households. The poverty rate in rural areas would change from 18.9 percent to 19.6 percent, and 10,564–24,138 people would become newly poor with about 77 percent of these individuals living in rural areas. Also, the poverty gap, which measures the additional consumption that the poor need to reach the poverty line, would increase from 1.7 percent to 6.3 percent. The size of the natural disaster shock would limit the opportunities or discourage people to move and reallocate across sectors, and therefore the share of poor populations in each sector would increase. Most important, the natural disasters will affect the population all along the income distribution, but mostly poor populations in the lowest quintiles of income and consumption. The per capita household income would decrease from 1.4 percent to 3 percent for the lowest quintile and from 1.7 percent and 2.7 percent for the highest quintile, respectively. Moreover, the shared prosperity indicator, which measures the growth of per capita consumption of the Bottom 40 (lowest two quintiles), shows that the negative effect on the lowest would be −0.68 percent to −2.1, whereas the effect on per capita consumption of the Top 60 (top three quintiles) would be only −0.62 percent to −1.77 percent.

In the absence of interventions to improve environmental quality or mitigate natural disasters, there are significant risks that could undermine economic growth and result in physical depletion of capital stock and nature assets. With this in mind, investing in prevention of natural disasters that are linked to environmental degradation and reducing the vulnerability of poor populations would put Georgia on a path to economic growth that is socially and environmentally sustainable. Various measures could increase the adaptation capacity to deal with natural disasters, such as measures for reducing forest loss, measures to combat soil erosion, and introducing postdisaster coping mechanisms for poor people. The immediate focus would be to improve coordination at the institutional level, improving weather hazard early warning systems and response to drought-affected farmers. Although the index-based pilot insurance schemes developed under the UNDP-run CC adaptation project for flood/flash flood and mudflows is a good start, expanding the coverage would be the way to go. The implementation of environmental legislation also needs to be improved as well as the planning of investments for modernizing the network of hydrological and meteorological observing stations, the number of which has declined sharply because of disinvestments.

Although environmental degradation and risk indicators analyzed under the macroeconomic lens (air pollution, exposure to lead, natural disaster risk) explain 80 percent of the environmental degradation in Georgia in 2012, it is clear that adverse health impacts from air pollution are of concern for all categories of the population. The underlying conclusion is that Georgia needs policy transformation to foster the monitoring of environmental assets in time and place (such as land resources, forest stock, mineral resources, and biodiversity), and to reduce direct pollution impacts that may influence human health and environmental quality (for example, air quality and access to basic environmental services). Such policies would guide a transition to a more resilient and cleaner economy and also would present economic opportunities that contribute to sustainable growth. Likewise, many of the implementation mechanisms and resources for reconciling environmental sustainability with economic growth and social improvements are yet to be put in place. The concerns about the environmental degradation in several sectors and slower economic growth indicate that Georgia needs to expand the policy debate on key environmental factors in sustainable development and devise solutions to reverse degradation.

Current policies need strengthening and realignment across economic sectors to take account of the loss of value of natural resources and the human health cost. On the one hand, focusing on selected policy measures can help reduce forest depletion, land degradation, and air pollution and simultaneously influence behavioral change—a win-win approach. On the other hand, it will help address the pending tradeoffs between economic growth and environmental degradation triggered by economic liberalization, and it will complement the harmonization of regulatory framework with EU *acquis*. This would be realized through the substantial opportunities for potential gains in the outcomes in many areas by introducing efficiency standards, adequate pricing mechanisms, innovation incentives, and the adoption of pollution reduction technologies. For example, introducing fuel and vehicle emission requirements (for example, Euro sulfur levels, levels recommended in WHO air quality guidelines) and strengthening monitoring and enforcement systems (for example, monitoring fuel quality at fuel retail stations and adopting taxation policies and incentives to stimulate the import and use of cleaner cars and fuels) as short-term measures would address the most pressing concern of air quality and human health impacts. Raising the importance of environmental protection by linking it to economic development and well-being would create more opportunities for the integration of environmental management and climate change in the country's development agenda.

Strengthening the effectiveness of environmental policy would require resources to help neutralize the negative ecological consequences of economic activities that undermine the natural resource base. During the period 2009–13, total spending on the environment amounted to an average of 0.37 percent of government spending, despite the fact that since 2012 the government program has defined environmental protection as one of its priorities. During the same period, as a percentage of GDP, the public environmental expenditure decreased from 0.2 percent to 0.09 percent. Given the amount of environmental problems that Georgia has to solve, budget resources fall short of what is needed to combat environmental degradation. Aligning environmental expenditures with policy priorities and areas of major concern such as air quality, land degradation, and solid waste management is a key for achieving sustainable outcomes.

Steps to align environmental policy and practice with international norms and standards as well as to combine environmental and economic levers to influence polluters' behavior are among the stated government priorities. Some of them related to harmonization with EU *acquis* are already under way. There is also an acute need to establish incentives for administrators to effectively enforce polices and reduce pollution.

Taking steps to reverse environmental degradation would reduce the underlying risks to Georgia's economic growth and would put the country on the road to sustainability. The following indicative list of actions could serve as a blueprint for addressing the issues studied in the CEA and could further benefit from a cost-benefit analysis of the actions, as a follow-up to the CEA in order to prioritize, determine their sequence, and allocate sufficient resources. These actions, if implemented consistently, could reinforce in a positive way the sustainability profile of Georgia.

IMPROVE AIR QUALITY

» Strengthen the current system of *air quality monitoring* by expanding air quality monitoring parameters/pollutants wherein the highest health impacts are observed; break down TSP emission monitoring into $PM_{2.5}$ and PM_{10}; introduce continuous monitoring for lead rather than monthly averages of discrete 20-minute measurements; monitor ground-level ozone at more stations in cities.

» Reestablish a fiscally neutral (from a public finance point of view) annual *vehicle technical inspection system* (emissions characteristics) with the necessary diagnostic equipment and technical staff; reintroduce vehicle registration and licenses to encourage adherence to emission standards and improvement of air quality.

» Introduce a system for regular *monitoring of fuel quality* at retail stations for lead content; limit sulfur in gasoline and diesel to a level compatible with the EU standards.

» Reform the current *system of pollution charges* for air, water, and generation of waste by introducing meaningful economic incentives.

REDUCE HEALTH IMPACTS FROM POOR INDOOR AIR QUALITY

» Expand programs for *reducing the use of household biomass fuels* for heating and cooking and address health risks associated with poor indoor air quality from open fires and traditional stoves, especially in rural areas.

» Develop policy on climate change mitigation and actions on *clean household energy* to maximize health and climate gains.

IMPROVE SOLID WASTE MANAGEMENT

» Promote innovation and adoption of effective *solid waste management* through commercial applications and through market forces for reduced waste generation and disposal.

- Reduce the *number of waste dumps* and the share of material assets and population at risk of exposure to untreated waste.
- Tighten the relationship between *public investments* in environmental infrastructure and national sustainability goals.

MANAGE FOREST RESOURCES

- Adopt the new *Forest Code*, with adequate provisions for forest management.
- Arrest forest loss and degradation of forestlands by reconciling the high demand for fuel wood in rural areas through expanding programs for *cleaner stoves and renewable energy in remote areas* and through developing sustainable scenarios for commercial production of timber and control of the transformation of land under forests.

REDUCE IMPACTS OF EXTREME WEATHER AND ARREST LAND DEGRADATION

- Strengthen economic incentives, governance structure and financial support for activities aiming to *mitigate land degradation and desertification* in areas prone to natural disasters.
- In agriculture, promote *adoption of drought-resistant cultivars*.
- Introduce better coordination at the institutional level to *improve the weather hazards early warning and response*.
- Expand the modernization of the *hydrological and meteorological observing network*.
- Consider targeted support to poor populations through the *social protection system for mitigation of natural disaster impacts*.
- Expand the index-based *disaster insurance system for* flood/flash flood and mudflows to protect the most vulnerable parts of the population.

ENHANCE ADMINISTRATIVE AND INSTITUTIONAL CAPACITY FOR POLICY IMPLEMENTATION

- Initiate capacity building for *environmental statistics* to ensure accuracy of data collection of environmental monitoring, including for reporting to meet regional and international conventions—national statistics office staff can be trained to improve measurement and provide information on the potential for using the UN System of Environmental-Economic Accounting.
- Strengthen the basis for policy development by adopting the methods and definitions used to generate *green accounts*, in which monetary values are assigned to natural capital and biological resources.

Which policies and actions are the most effective, economically efficient, administratively feasible, and politically acceptable to resolve Georgia's current environmental degradation problems? Countries that have addressed similar problems and improved environmental management systems have created an enabling governance framework through coordination and cooperation among various stakeholders and through clear regulatory mandates. Incentives for behavioral changes need to be supported by strong implementation mechanisms and regular evaluation. Successful strategies to mitigate environmental degradation have to incorporate quantitative targets in the national laws and programs across sectors. Georgia should take advantage of the international cooperation and financing that can be a major source for transfer of new environmental management "know-how," efficiency improvements, and knowledge of clean development.

As Georgia moves toward sustainable development, by taking steps to reverse environmental degradation it will further benefit from a comprehensive national strategy that combines "green growth" and development with the efficient use of natural resources and environmental services. Planning investments to address environmental degradation and promoting "green" innovation will contribute to sustainable growth in the medium run and will create new economic opportunities. "Green growth" could lay a foundation for mutually reinforcing economic and environmental policies, taking into account a full value of natural capital as a factor of production and for its role in growth. The transition to a new pattern of growth will include cost-effective ways to mitigate environmental pressures and to avoid crossing critical local, regional, and global environmental thresholds. Mitigation of environmental and natural resource degradation will foster economic growth in the long run and promote poverty alleviation, as poor populations are the people who suffer the most from polluted localities and natural resource degradation.

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APPENDIX A
DONOR-FINANCED ENVIRONMENTAL ACTIVITIES

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Nature Protection Program—Southern Caucasus—Establishment of Javakheti NP in Georgia	01-01-09	31-12-14	GEL	5,208,790	4,950,000	Javakheti	Protected Areas	KFW, Federal Ministry for Economic Cooperation and Development (BMZ)	WWF Germany
Integrated Natural Resources Management in Watersheds (INRMW) of Georgia	01-11-10	31-08-14	USD	6,500,000	6,500,000	Alazani, Iori, Rioni rivers basins	Protected Areas Water Resources	USIAD	Global Water for Sustainability Program (GLOWS) consortium
The HCFC Phase-out Management Plan (HPMP)	01-03-12	31-12-20	USD	538,468	538,468	Whole Country	Ambient Air	Multilateral Fund for the Implementation of the Montreal Protocol	UNDP Georgia
Air Quality Governance in the ENPI East Countries—AIR-Q-GOV	01-01-11	31-12-14	EUR	6,935,000	6,935,000	Georgia, Armenia, Azerbaijan, Belarus, Republic of Moldova, Russian Federation, and Ukraine	Ambient Air	The European Commission	Consortium of organizations composed of MWH (Lead Partner), CENN, FORCE, GOPA, MAMA-86, NERI-AU CENN
Ensuring Sufficiency and Predictability of Revenues for the Georgia's Protected Areas System	01-09-10	31-12-16	USD	5,440,000	1,000,000	Various Regions	Protected Areas	GEF,CNF	UNDP
Transboundary Joint Secretariat for the Southern Caucasus (TJS) (II Phase)	01-01-11	31-12-14	EUR	3,500,000	1,500,000	Georgia, Armenia, Azerbaijan	Protected Areas	KFW, Federal Ministry for Economic Cooperation and Development (BMZ)	Transboundary Joint Secretariat
Demonstrating and Scaling up Sustainable Alternatives to DDT for the Control of Vector Borne Diseases in Southern Caucasus and Central Asia	01-11-10	01-10-15	USD	5,482,000	2,400,000	Georgia, Kyrgyzstan, Tajikistan	Waste and Chemicals	GEF, Green Cross	UNEP

Comp: do not indent turnovers. Please fix throughout Appx A table.

Infectious Healthcare Waste Management in Georgia	01-03-11	31-12-14	EUR	382,000	382,000	East and West Georgia	Waste and Chemicals	Government of the Netherlands	Ameco International
Disposal of POPs Pesticides and Initial Steps for Containment of Dumped POPs Pesticides in Georgia	01-02-12	31-12-14	USD	3,141,080	1,150,000	Tbilisi and Marneuli	Waste and Chemicals	GEF, UNDP	UNDP
Arsenic Containing Mining Waste in Georgia	01-01-11	31-05-14	EUR	750,000	750,000	District Racha Lekhumi, and Kvemo Svaneti	Waste and Chemicals	Government of the Netherlands	Witteveen+Bos Consulting Company
Sustainable Management of Biodiversity, South Caucasus	01-06-08	01-11-17	EUR	20,597,000	n/a	Georgia, Armenia, Azerbaijan	Biodiversity	Federal Ministry for Economic Cooperation and Development (BMZ); Austrian Development Agency (ADA)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Grant Agreement Lagodekhi Protected Areas	01-01-14	31-12-16	EUR	270,000	270,000	Kakheti region	Protected Areas	CNF	The Agency of Protected Areas of Georgia
Support Programme for Protected Areas in the Caucasus—Georgia (Ecoregional Programme Georgia, Phase III)	01-01-14	31-12-19	EUR	8,250,001	8,250,000	Regions: Pshav-Khevsureti, Kazbegi, Qvemo Kartli, and Adjara	Protected Areas	Federal Ministry for Economic Cooperation and Development (BMZ); KFW	GFA Consulting Group
Enhanced Preparedness of Georgia Against Extreme Weather Events	01-01-11	31-05-14	EUR	568,900	568,900	Tbilisi, Mtskheta-Tianeti, Kvemo Kartli, Shida Kartli, Samegrelo-Svaneti, Kakheti	Disasters	Czech Development Agency	The National Environmental Agency of the Ministry of the Environment Protection of Georgia
Reducing Transboundary Degradation of the Kura Aras River Basin	21-06-11	20-06-14	EUR	2,900,000	960000	Georgia, Armenia, Azerbaijan	Water Resources	GEF; UNDP	Project Coordination Unit, Tbilisi

(continued)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Advancement of Protected Areas Effectiveness for the Integrated Natural Resources Management in Watersheds	01-06-11	01-06-14	USD	640000	640000	The basins of the Engury-Rioni and Alazani-Iori rivers and transboundary zones in Kakheti and Adjara	Protected Areas	USAID; USDOI	United States Department of the Interior, International Technical Assistance Program(DOI-ITAP)
Enabling Activities for the Preparation of Georgia's Third National Communication to the UNFCCC	01-07-11	30-06-14	USD	600000	500000	The project should cover whole country in general issues (for example, GHG inventory), but regarding the particular sectors, such as vulnerability and mitigation, the targeted regions are Adjara, Kakheti, Zemo-Svaneti	Climate Change	GEF	UNDP (UN Development Program)
Promote Sustainable Livelihoods and Responsible Attitude to Environment	01-04-12	01-03-15	EUR	1179677	1179677	Daba and Tsagveri in Borjomi Municipality, Samtskhe-Javakheti	Forestry	Government of Finland	UNDP Georgia
Enhancing local capacity and regional cooperation for climate change adaptation and biodiversity conservation in Georgia and the South Caucasus	01-12-11	30-11-14	EUR	1,438,725	1,150,980	Kakheti Region—Dedoplistskaro, Signagi, Sagarejo municipalities; Kvemo Kartli Region—Dmanisi, Bolnisi, Marneuli	Climate Change	The European Union	Mercy Corps Georgia

						municipalities; Samtskhe-Javakheti Region—Ninotsminda municipality			
Grant Agreement Borjomi-Kharagauli National Park	01-01-13	31-12-15	GEL	2990470	1,355,276	Samtskhe-Javakheti, Imereti, Shida Kartli	Protected Areas	CNF	The Agency of Protected Areas
Grant Agreement Mtirala National Park	01-01-13	31-12-15	GEL	943,359	943,359	Adjara region	Protected Areas	CNF	The Agency of Protected Areas
Grant Agreement Tusheti Protected Areas	01-01-12	31-12-14	GEL	1,268,780	664580	Kakheti; Akhmeta municipality	Protected Areas	CNF	The Agency of Protected Areas
Grant Agreement Vashlovani Protected Areas	01-01-12	31-12-14	GEL	1,365,643	692923	Georgia, Azerbaijan, Armenia	Protected Areas	CNF	The Agency of Protected Areas
Expansion and Improved Management Effectiveness of the Adjara Region's Protected Areas	01-01-14	31-12-17	USD	14,998,778	1323636	Adjara	Protected Areas	GEF	United Nations Development Programe (UNDP)
Preparation of Management Plan for Tusheti Protected Landscape	01-01-12	10-04-14	USD	107000	107000	Kakheti	Protected Areas	Czech Development Agency	Nature Conservation Agency of the Czech Republic, Akhmeta Municipality
Strengthening of Management of Protected Areas of Georgia—TWINNING	01-01-13	10-04-15	EUR	1,100,000	1,100,000	Kakheti, Imereti, Adjara	Protected Areas	The European Union	Consortium of Austria-Czech Republic
Developing Climate Resilient Flood and Flash Flood Management Practices to Protect Vulnerable Communities of Georgia	01-01-12	10-04-16	USD	5,060,000	4900000	Tsageri, Lentekhi, Oni, Ambrolauri, Tskaltubo da Samtredia	Climate Change	Adaptation Fund	National Environmental Agency
Environmental Protection of International River Basins Project (EPIRBP)	30-01-12	29-01-16	EUR	7500000	7500000	Georgia, Armenia, Azerbaijan, Belarus, Moldova, Ukraine	Water Resources	The European Commission	The Human Dynamics Consortium

(*continued*)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Alignment of National Action Program and Preparation of the Second Leg of the Fourth Reporting and Review process	15-10-12	31-07-14	USD	377,000	150000	Regions: in the process of identification by the project	Land Resources	GEF	Regional Environmental Centre for Caucasus
Phase III: Enhancing National Capacity on Fire Management and Wildfire Disaster Risk Reduction in the South Caucasus: Phase Three	01-01-12	31-12-13	EUR	95872	31,960	Armenia, Azerbaijan, Georgia	Disasters	ENVSEC	OSCE
Promotion of Biomass Production and Utilization in Georgia	01-01-13	31-12-16	USD	5,380,000	5,380,000	Samegrelo-Zemo Svaneti	Climate Change	GEF	Ministry of Environment and Natural Resources Protection of Georgia
ClimaEast: Supporting climate change mitigation and adaptation in ENP East countries and Russia	01-01-13	31-12-16	EUR	7,000,000	1389609	Azerbaijan, Armenia, Georgia, Russia, Moldova	Climate Change	The European Commission	Consortium (HTSPE, AEA Technology, Ecofys,IIASA and Milieu Ltd)
Clima East Pilot Project: "Sustainable management of pastures in Georgia to demonstrate climate change mitigation and adaptation benefits and dividends for local communities"	01-04-13	31-12-16	USD	1,375,800	1,375,800	Dedoplistskaro Region	Protected Areas	The European Union; UNDP; GEF	UNDP
"Greening Economies in the Eastern Neighbourhood" (Eap Green) Program	01-01-13	31-12-16	EUR	12500000	2085000	Armenia, Azerbaijan, Belarus, Georgia, Republic of Moldova, Ukraine	Environmental Impact Permits	The European Union	OECD; UNECE; UNEP; UNIDO

Upgrading Cancer Management at the High Technology Medical Centre, University Clinic	01-01-14	31-12-15	EUR	17780	17780	Tbilisi, Georgia	Nuclear and Radiation Safety	International Atomic Energy Agency	High-Technology Centre, University Clinic, Department of Radiation Oncology
"Support to the Operators in the Preparation of Safety Assessment Reports for Georgian Radioactive Waste Disposal and Interim Storage Sites"	01-01-14	31-12-14		n/a	n/a	Mtshketa reactor site (centralized storage facility) and Saakadze waste disposal site (Gardabani district, near the village of Saakadze)	Nuclear and Radiation Safety	The European Commission	German Consortium (TUV Nord and DBE)
Improving Environmental Monitoring in the Black Sea (EMBLAS)	01-01-13	31-12-14	EUR	1060000	353333	Georgia, Russia, Ukraine	Water Resources	The European Union; UNDP	UNDP
Grant Agreement—Insurance for the Protected Areas Staff (Territorial Administrations)	01-01-13	31-12-14	EUR	67,850	67,850	n/a	Protected Areas	CNF	The Agency of Protected Areas
Improving capacities to eliminate and prevent recurrence of obsolete pesticides as model for tackling unused hazardous chemicals in the former Soviet Union	01-01-12	31-12-15	EUR	7,000,000	1000000	Georgia, Armenia, Azerbaijan, Republic of Belarus, Kyrgyz Republic, Moldova, Ukraine	Waste and Chemicals	FAO	FAO
Enhancing Capacity for Low Emission Development Strategies EC-LEDS Clean Energy Program	01-09-13	01-09-17	USD	6,076,168	6,076,168	n/a	Climate Change	USAID;	Winrock International/ Georgia
Pilot Demonstration Project on ODS [Ozone-Depleting Substances], Waste Management and Disposal in Georgia	01-03-14	30-06-15	USD	55264	55264	n/a	Ambient Air	Multilateral Fund for the Implementation of the Montreal Protocol	UNDP Georgia

(*continued*)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Sustainable Forest Governance in Georgia: Strengthening Local and National Capacity and Developing Structured Dialogue	01-07-12	01-07-15	USD	602,206	489,691	Adjara, Samegrelo-Zemo Svaneti, Racha-Lechkhumi and Kvemo Svaneti, Mtskheta-Mtianeti, Samtskhe-Javakheti, Kakheti, Kvemo Kartli	Forestry	Austrian Development Agency (ADA)	Caucasus Environmental NGO Network (CENN)
Japan's Non-Project Grant Aid for Provision of Japanese SME's Products	11-06-14	31-10-15	JPY	200000000	200000000	Whole Country	Climate Change	Government of Japan	National Environmental Agency (NEA)
Enabling Activities Program for Implementation of the Montreal Protocol in Georgia (Institutional Strengthening Project phase VIII)	01-04-14	01-04-15	USD	60667	60667	Whole Country	Ambient Air	Multilateral Fund for the Implementation of the Montreal Protocol	UNDP Georgia
Establishment of Internal Reserve for Training Rangers	01-05-14	01-09-14	GEL	63,605	63,605	Whole Country	Environmental Information and Education	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	LEPL Environmental Information and Education Centre
Aarhus Centres in the South Caucasus	01-02-14	31-12-14	EUR	35,490	35,490	Whole Country	Environmental Information and Education	OSCE	LEPL Environmental Information and Education Centre
Assessment of Environment Education in Georgia	04-03-14	30-11-14	GEL	47,455	47,455	Tbilisi	Environmental Information and Education	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	LEPL Environmental Information and Education Centre
Prevention & Preparedness at National Level (Phase II)	01-01-14	31-12-16	CHF	625,000	625,000	Whole Country	Disasters	Swiss Agency for Development and Cooperation (SDC)	Swiss Cooperation Office for the South Caucasus

Integrated erosion control measures in the South Caucasus	01-04-14	31-12-16	EUR	2000000	2000000	Georgia, Armenia, Azerbaijan	Land Resources	Federal Ministry for Economic Cooperation and Development (BMZ); Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH	Eco Consulting Group
Administrating National Protected Areas Network and Practical Nature Conservation	01-01-14	31-12-15	EUR	46105	46105	Georgia, Estonia	Protected Areas	Ministry of Foreign Affairs of Republic of Estonia	Estonian Environmental Board
Addressing Emergency Environment and Security Threats at the Arsenic Mining Site in Tsana, Georgia	01-01-13	31-12-14	EUR	50,000	50,000	Lentekhi District	Waste and Chemicals, Disasters, Land Resources	ENVSEC; Government of Finland	OSCE and UNEP/ OCHA
Waste Management Technologies in Regions (WMTR)	18-03-14	17-03-18	USD	4,779,286	4,779,286	Kakheti and Adjara regions	Waste and Chemicals	USAID	International City/ County Management Association (ICMA)
Pilot Project for Introduction of an Information System for Data Transferring and Groundwater Monitoring Network in Kvareli and Lagodekhi Municipalities	01-03-14	30-11-15	EUR	40000	40000	Kakheti	Water Resources	Czech Development Agency	National Environmental Agency (NEA)
European Neighborhood and Partnership Instrument East Countries Forest Law Enforcement and Governance II Program (ENPI-FLEG II)	01-10-13	31-12-16	USD	1,910,429	1,910,429	Georgia, Armenia, Azerbaijan, Belarus, Molodova, Russian Federation, Ukraine	Forestry	The European Union; Austrian Development Agency (ADA)	World Bank; WWF Caucasus; IUCN

(*continued*)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Completed Projects									
Support to Kyoto Protocol Implementation	01-09-08	30-09-11	EUR	4,787,000	4,787,000	Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan	Climate Change	The European Commission	Consortium of ICF—TUV—H&H
Promoting the Use of Small Hydro Resources at Community Level	01-11-05	30-05-11	USD	1,059,951	1,059,951	Kakheti, Imereti, Racha	Climate Change	Government of Norway; UNDP	UNDP; Implementing Partner: Ministry of Environment Protection of Georgia; Overall management—Project Supervisory Committee
The ENPI East Waste Governance Project	01-01-10	31-12-13	EUR	5,800,000	800,000	Armenia, Azerbaijan, Belarus, Georgia, Moldova, Russia, Ukraine	Waste and Chemicals	The European Union	Eptisa together with REC Caucasus
Catalyzing Financial Sustainability of Georgia's Protected Areas System	01-05-09	30-06-12	USD	875,420	875,420	All protected Areas	Protected Areas	UNDP; GEF	UNDP
Promoting the Use of Renewable Energy Resources for Local Energy Supply	01-05-04	29-06-12	USD	13,690,000	######	All Regions	Climate Change	GEF; KFW	UNDP; Implementing Partner: Ministry of Environment Protection of Georgia; Overall management—Project Supervisory Committee

Development of the National Environmental Action Plan—2	01-10-09	01-09-11	EUR	120,000	120,000	Whole Country	Cross-cutting issues	Government of the Netherlands	Ministry of Environment Protection
Transboundary River Management Phase II for the Kura River Basin	01-01-08	31-12-11	EUR	5,000,000	1,700,000	Armenia, Azerbaijan, Georgia	Water Resources	The European Commission	Eptisa & Grontmij-CarlBro consortium
Pilot Project Air Quality Monitoring System in Tbilisi, Georgia	01-01-11	31-12-13	EUR	700,000	700,000	Tbilisi	Ambient Air	Government of the Netherlands	CENN
Aarhus Centre Georgia	01-01-12	28-02-13		n/a	n/a	Whole Country	Cross-cutting issues	ENVSEC	OSCE
Regional Climate Change Impacts Study for the South Caucasus Region	01-01-10	30-06-11	USD	148,000	67,120	Armenia, Azerbaijan, Georgia	Climate Change	ENVSEC	UNDP Georgia
Support of EIA, Permitting and Inspection for the Georgian Ministry of Environment Protection	01-03-12	31-07-13	EUR	350,000	350,000	Whole Country	Environmental Impact Permits	Government of the Netherlands	Netherland Commission for Environmental Assessment (NCEA)
Environmental Assessment and Capacity Building in Tbilisi	01-06-10	31-10-11	EUR	110,000	110,000	Tbilisi	Cross-cutting issues	ENVSEC	UNEP/OSCE
Implementation of the UNECE Water Convention and Development of an Agreement on the Management of Transboundary Watercourses Shared by Georgia and Azerbaijan	01-01-10	31-03-12	EUR	85,830	30,000	Azerbaijan, Georgia	Water Resources	ENVSEC	UNEP/OSCE
Upgrade Black Sea Scene Project (UBSS)	01-01-09	31-12-11	EUR	36,000	36,000	For all countries of the Black Sea and several countries of the EU	n/a	The European Commission	n/a
Development of a Sanitary Landfill for Household Waste in Borjomi, Georgia	01-01-11	31-12-14	EUR	1,200,000	1,200,000	Samtkhe-Javakheti, Borjomi	Waste and Chemicals	Government of the Netherlands	Ameco International

(*continued*)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Twinning Project "Strengthening the Capacity of the Ministry of Environment Protection in the Field of Waste and Hazardous Substances Management and Improving the Environmental Conditions in Georgia"	01-07-11	30-06-14	EUR	1,250,000	1,250,000	All regions of Georgia	Waste and Chemicals	The European Union	Austrian-Bulgarian Consortium
Capacity Building on Obsolete and POPs Pesticides in Easter European, Caucasus and Central Asian (EECCA) Countries	01-01-10	31-12-13	USD	2,396,550	1,614,000	Albania, Armenia, Azerbaijan, Belarus, Georgia, Moldova, Romania, Macedoni	Waste and Chemicals	GEF; Green Cross	Ministry of Agriculture of Georgia with the Ministry of Environment Protection of Georgia
Implementation of the Strategic Action Plan for the Protection and Rehabilitation of the Black Sea (BBSAP)	01-11-10	31-12-11	EUR	190,000	190,000	Adjara	n/a	Federal Ministry for Economic Cooperation and Development (BMZ)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Climate Tolerant Rehabilitation of Degraded Landscapes	01-11-08	31-10-11	EUR	1,190,000	1,190,000	Dedoplistskaro	Protected Areas	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
Delivering Protected Area Capacity and Engaging Traditional Pastoral Communities to Conserve Georgia's Unique and Internationally Important Biodiversity	01-01-09	31-05-12	EUR	1,113,111	1,113,111	Kakheti, Tusheti	Protected Areas	The European Commission; FFI	NACRES—Centre for Biodiversity Conservation and Rsearch

Support for the Implementation of the Convention on Biological Diversity Programme of Work on Protected Areas in the ENP East Area and Russia: Extension of the Implementation of the EU's Natura 2000 Principles through the Emerald Network	01-08-09	30-11-11	EUR	110,000	110,000	Whole Country	Protected Areas	The European Commission	Legal Entity of Public Law the Agency of Protected Areas of the Ministry of Environment Protection of Georgia and NGO Nacres
Renewable Energy for Remote Areas of Georgia—Photovoltaic Panels in Tusheti	01-01-10	31-12-11	EUR	268,846	268,846	Georgia, Kakheti region, Akhmeta municipality	Protected Areas	Czech Development Agency	SUNNYWATT CZ s.r.o.
Grant Agreement Borjomi Kharagauli National Park	01-01-10	31-12-13	EUR	340,000	340,000	Borjomi, Kharagauli	Protected Areas	CNF; Bank of Georgia	The Agency of Protected Areas of Georgia
Implementation of Ktsia-Tabatskuri Management Plan	11-06-09	31-12-10	USD	170,000	150,000	Borjomi district	Protected Areas	BTC CO and SCP	IUCN
Capacity Development of Public Relations Service of Ministry of Environment Protection of Georgia	24-05-10	24-12-12	USD	132,635	80,000	Georgia	Cross-cutting issues	UNDP	Ministry of Environment Protection
Enabling Activities Program for Implementation of the Montreal Protocol in Georgia (Institutional Strengthening Project phase VII)	01-03-12	31-12-13	USD	60,667	60,667	Whole Country	Ambient Air	Multilateral Fund for the Implementation of the Montreal Protocol	UNDP Georgia
Natural Solutions to Climate Change: The Role of Protected Areas	01-12-11	01-11-12	EUR	102,985	99,985	Tentative: Kakheti (Dedoplistskaro), Adjara	Protected Areas	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	IUCN Caucasus Cooperation Center

(continued)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Increase Effectiveness of wilderness protection through improved interpretation in Borjomi-Kharagauli National Park	01-04-12	30-09-12	EUR	10,000	10,000	Borjomi	Protected Areas	Toyota Fund	NGO "Tsiplari"
Renewable Energy for Remote Areas of Georgia—Photovoltaic Panels in Tusheti (Phase II)	01-12-11	01-12-13	EUR	260,000	260,000	Kakheti	Protected Areas	Czech Development Agency	Sun House
Support for Georgia in the Field of Protected Areas Development	01-03-12	01-06-14	EUR	489,240	489,240	Regions: Adjara, Imereti, Kakheti	Protected Areas	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety (BMU)	World Tourism Organization (UNWTO)
Support of the implementation process of the EU Directive on assessment of the flood risks into the legislation in Georgia	01-01-12	31-01-13	EUR	80,800	80,452	Whole Country	Disasters	Slovak Aid Agency	National Environmental Agency
Technology Needs Assessment (TNA)	01-09-11	31-05-12	USD	120,000	120,000	Bangladesh, Bhutan, Cambodia, Georgia, Indonesia, Mongolia, Nepal, Sri Lanka, Thailand, Vietnam	Climate Change	GEF; UNDP	UNEP Riso Centre
Strengthening Capacities for Developing a National Pollutant Release and Transfer Register and Supporting SAICM Implementation in Georgia	06-03-09	15-04-12	USD	189,500	170,500	n/a	Ambient Air	SAICM Quick Start Programme Trust Fund	CENN

Grant Agreement Borjomi-Kharagauli National Park (2010–2012)	01-01-10	31-12-12	EUR	298,606	276,800	Samtskhe_ Javakheti, Imereti, Shida Kartli	Protected Areas	CNF	The Agency of Protected Areas
Grant Agreement Lagodekhi Protected Areas (PCB)	01-01-12	31-12-12	USD	10,000	10,000	Kakheti	Protected Areas	CNF	The Agency of Protected Areas
Interpretative Trails on the Ground-Support to the Management of Natural Protected Areas in the Black Sea Region (Inter Trails).	01-10-11	01-10-13	EUR	397,597	79,520	Bulgaria, Romania, Ukraine, Moldova, Georgia	Protected Areas	The European Union	Black Sea NGO Network –applicant
Future of worlds unique Ramsar site Ispani mire in: conservation, restoration and eco-tourism Infrastructure development	01-01-11	05-04-13	USD	42,520	n/a	Adjara	Protected Areas	Ramsar Convention	Society for Conservation of Wild Nature “Tchaobi”
National Policy Dialogue in Georgia on Integrated Water Resources Management	01-11-10	16-04-13	USD	28,000	28,000	Whole Country	Water Resources	United Nations Economic Commission for Europe	Global Water Partnership Georgia
Aarhus Centre Georgia	01-03-13	31-08-14		n/a	n/a	Whole Country	Cross-cutting issues	ENVSEC	The Center of Environmental Information and Education
Strengthened Multi-Stakeholder Cooperation in the South Caucasus for Improved Protected Areas Systems	01-11-11	31-12-13	EUR	60,291	20,097	Armenia; Azerbaijan; Georgia	Protected Areas	ENVSEC	OSCE
Implementation of the UNECE Water Convention: Finalisation of an agreement on the management of transboundary watercourses shared by Georgia and Azerbaijan	01-02-13	31-12-13	EUR	16,810	8,405	Azerbaijan, Georgia	Water Resources	ENVSEC	OSCE

(*continued*)

Ongoing Projects	Start Date	End Date		Total Budget	Total Grant	Target Area	Sphere	Donors	Implementer
Increased efficiency of management of Imereti Caves Protected Areas (ICPA)	02-01-12	31-12-13	EUR	102,440	102,440	Imereti	Protected Areas	Czech Development Agency	ISCA - Association of Czech Caves
Survey and Strategic Assessment of Georgian Radwaste Disposal and Interim Storage Site	01-01-12	31-12-13	EUR	858,000	858,000	Georgia	Nuclear and Radiation Safety	The European Commission	"Enconet" Consortium of "Enco" (Austria)

APPENDIX B
COUNTRY ENVIRONMENTAL ANALYSIS—METHODOLOGY

The monetary valuation of environmental externalities or environmental damage, and quantification of environmental damage, involves many scientific disciplines including environmental, physical and biological, health sciences and epidemiology, and environmental economics. This methodology provides guidance for future in-depth analysis highlighting the focus areas with potentially high environmental externalities. CoED focuses on "cost of inaction." This methodology is widely used in the Bank and aims to communicate the current level of the negative impact on environment and natural resources

Several standard diagnostic tools were used in the CEA analysis. Literature reviews identified the extent of environmental problems in selected areas to reach an agreement with stakeholders on the priority areas of the analysis. The data were collected through reviews of documents, reports, and other materials, including Internet sites and maps; field interviews; and official government sources. The data collection was followed by quantification of the problem through assigning monetary value to environmental degradation. The analysis included three distinct steps, which were conducted in the following sequence:

1. **Cost of environmental degradation,** which applies a bottom-up approach for ranking relative social costs of various forms of degradation and expresses the damage costs as a percentage of GDP, allowing for comparison with other economic indicators.
2. **Macroeconomic analysis,** which uses a static computable general equilibrium model developed for Georgia (based on Global Trade Analysis Project data, 2011) for caculating the macroeconomic impact of COED and poverty incidence in 2012 using a CGE–Economic baseline that describes the Georgian economy in 2012 and a CGE–Environmental baseline.
3. **Poverty impact simulations,** which uses the ADePT simulation module to simulate the effect of natural disasters on poverty, applying the results of the CGE model (macrolevel) combined with household data from the Integrated Household Survey of Georgia of 2012 (microlevel).

A. COST OF ENVIRONMENTAL DEGRADATION

- CoED creates a benchmark to identify and prioritize interventions to reduce environmental damage, it is first stage of a conventional cost-benefit analysis.
- CoED concentrates on health losses from air pollution (ambient and household), neurotoxic effect of exposure to lead, land degradation, deforestation, solid wastes and natural disasters.

Air pollution: Particulate matter is the ambient air pollutant that globally is associated with the largest health effects. PM is also a major household air pollutant from the burning of solid fuels for cooking and, in cold climates, heating. Health effects of PM exposure include both premature mortality and morbidity. The methodologies to estimate these health effects have evolved as the body of research evidence has increased. Health risks associated with exposure to $PM_{2.5}$ are estimated using methods described in Burnett et al. (2014) and Lim et al. (2012). These studies develop an integrated exposure-response relative risk function (RR) over the entire global range of ambient $PM_{2.5}$ for five leading causes of death: ischemic heart disease (IHD), cerebrovascular disease (stroke), chronic obstructive pulmonary disease (COPD), lung cancer (LC), and acute lower respiratory infections (ALRI) in children aged 0–4. The risk functions are then used to estimate mortality and morbidity associated with air pollution in Georgia. In the absence of $PM_{2.5}$ ambient air monitoring data, available TSP monitoring data are converted into annual average $PM_{2.5}$ concentrations based on the PM composition in Russia and Armenia. Background mortality data for 2013 reported by WHO are applied in the analysis. Additional morbidity is estimated proportionally from DALYs loss because of additional mortality and additional morbidity as presented in GBD 2012. For household air pollution, the share of households that rely on solid fuel for cooking is adopted from the Georgia Poverty Assessment (2014). The share of improved stoves is reported in MICS (2006) for Georgia. Corresponding levels of PM pollution in households are adopted from literature. The same integrated exposure-response relative risk function is applied for household air pollution, as for ambient air pollution. Mortality and morbidity are valuated using the Value of Statistical Life (VSL) approaches. Benefit-transfer is applied to transfer the VSL developed for OECD countries to Georgia.

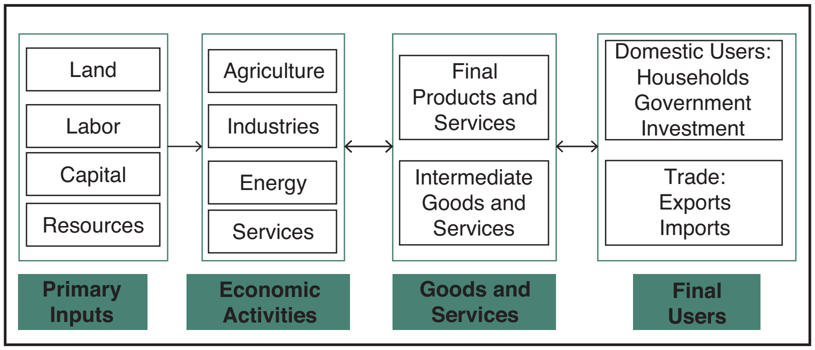
Lead exposure: Exposure to lead has a significant neurotoxic effect on children. In urban areas children inhaled or ingested lead liberated as a result of the combustion of leaded gasoline and their BLL increased. Increased BLL is associated with adverse health consequences, including cognitive and behavioral deficits (Fewtrell, Kaufmann, and Pruss-Ustun 2003). BLL level in children is estimated applying the model developed by Attina and Trasande (2013), based on the analysis of major gasoline importers to Georgia and timing of lead phase-out in these countries. WHO methodology is applied to estimate the share of children with BLL above 2 μg/dL. Latest studies suggest that loss of cognitive abilities is associated with BLL ≥2 μg/dL in children. Then, following Fewtrell, Kaufmann, and Pruss-Ustun (2003) methodology loss of IQ is estimated for children under 5 years old in different BLL groups (the population at risk is represented by each 1-year cohort of children under 5 years of age). The valuation of resulted IQ loss utilized suggested association of an individual's income with the individual's IQ score. This has long been empirically established by, for instance, Schwartz (1994) and Salkever (1995). These two studies found that a decline of one IQ point is associated with a 1.3–2.0 percent decline in lifetime income. The present value of future lifetime income of a child under 5 years is estimated at US$108,000 based on an estimated average annual income in 2012 of US$3,550 in Georgia. Cost of lost I points in Georgia is estimated as the product of income loss per lost IQ point (midpoint estimate in Schwartz [1994] and Salkever [1995]) and the percentage of children who may be expected to participate in the labor force (67 percent in Georgia from WDI 2014). Expected labor-force participation is assumed to be the same as the current rate of participation.

Land degradation: Loss of agricultural productivity estimated at current market prices is the basis of cropland and pasture degradation valuation. In total, about 66 percent of agricultural lands are eroded or degraded. These lands may be abandoned if their productivity is reduced. It is assumed that about 20–25 percent is associated with losses caused by agricultural land degradation. Overgrazing cost is estimated based on livestock productivity reduction. The productivity of the overgrazed lands does not provide the nutrition required for stock fattening or higher milk yield. Production losses are estimated at the import prices, as Georgia imports quite substantial amount of agricultural produce (FAO, 2014).

Deforestation: Deforestation in physical terms is reported by Global Forest Watch for Georgia. Cost of deforestation is estimated following the concept of ecosystem services (ESS), which are derived from the complex biophysical systems. Ecosystem services are divided into four groups, provisioning, regulating, cultural, and supporting, and under each there are a number of subcategories. In this study, we have used the concept of ESS to value losses in wet and temperate forests of Georgia applying benefit-transfer from the recent meta-analysis of ESS values. There are several meta-analysis studies of ecosystem services values available (Costanza et al. 2014; Hussain et al. 2011). The Groot study is a background estimate provided by the TEEB project (http://www.teebweb.org). The Groot study presents meta-analysis of different ecosystem services valuation studies worldwide. This study gives a good summary of reported values of ecosystem services in different ecosystems, including tropical forests and boreal/temperate forests. Based on unit monetary values of ecosystem services presented in tables 3.5 and 3.6 (we apply conservative median values in this study), two different categories of ecosystems emerge: tropical forests estimated at about US$2,100 per ha per year and temperate forest at about US$1,100 per ha per year, climate service excluded. Then the estimate of annual forest value in Georgia is estimated at a range of US$2,100–US$1,100 per ha per year without climate service. The total amount of carbon accumulated in 1 hectare of forest in Georgia is estimated at 88 tons/hectare for wet forests and 38 t/hectare for dry forests as in Georgia report for the (FAO Forest Assessment, Georgia Report 2010). In this report, carbon is valued based on the social cost of carbon calculated at a 5 percent discount rate (US$12 per ton of CO_2), which represents a conservative estimate of social cost but is above current commercial value of carbon offsets (Golub 2014). One-time cost of lost climate regulation services is a product of social cost of carbon, annual average ecosystem area loss, and carbon sequestered and stored by 1 hectare of lost ecosystem. Note that all calculations are performed in CO_2 equivalents. The annual value of ecosystem services losses is estimated as NPV of flow of net benefits from lost ecosystem area and one-time cost of carbon lost in deforested areas. This flow of net benefits is a product of a value of ecosystem services and annual average ecosystem area loss over the period 2001–12. In order to capitalize the flow of ecosystem services the lost value (excluding climate services) is calculated by applying a 3 percent discount rate to the NPV.

Solid Waste: Damages from the disposal of solid waste included estimation of dis-amenity from waste not collected and dis-amenity from proximity to landfills. If the waste is not properly collected, it imposes a dis-amenity

FIGURE B.1. STRUCTURE OF THE CGE MODEL



and health risks. As a rule of thumb, a figure of 1 percent of the income of people in the areas where there is no collection is used as a guide for this cost (Markandya and Golub 2013). There are 63 official and 28 unofficial landfills in Georgia. It is assumed that 30 percent of the population has no official solid wastes collection. The loss of amenity value around active landfills is based on the fact that land prices are known to decline as a result of the operations of an active landfill when there is housing around or potential for housing to be developed around the site. The estimate utilizes transfer of the rate of decline of land values with distance from an active site, even if it is well run. This arises from the extra traffic, odor, and so on that are associated with a landfill.

Natural Disasters: In Georgia, a significant study was conducted to estimate annual risk from natural disasters (CENN and ITC 2012). The document provides important background information for both hazards and exposure to natural disasters by region in Georgia. Only natural disasters usually associated with anthropogenic activity, such as deforestation, improper agricultural practices and climate change, are included in the cost of natural disasters estimated in this report. Given limited annual data available for direct GDP loss and causalities on a national level for a relatively short time period (14 years), frequency and severity of natural disasters distribution is assessed. Based on flood frequency and severity, it is plausible to predict 1 SD and 2 SD events during any selected year that corresponds to low and high estimates. Cost of buildings is estimated at US$30,000–US$50,000, crop at US$280 per hectare (marginal crop land productivity as in FAO 2014).

B. COMPUTABLE GENERAL EQUILIBRIUM ANALYSIS

» CoED provides a background scenario to increase welfare and encourage green growth through efficient resource allocation in the long term, applying CGE model

» CGE simulation results provide a background for spatial/distributional analysis and estimation of environmental costs for the less resilient population groups

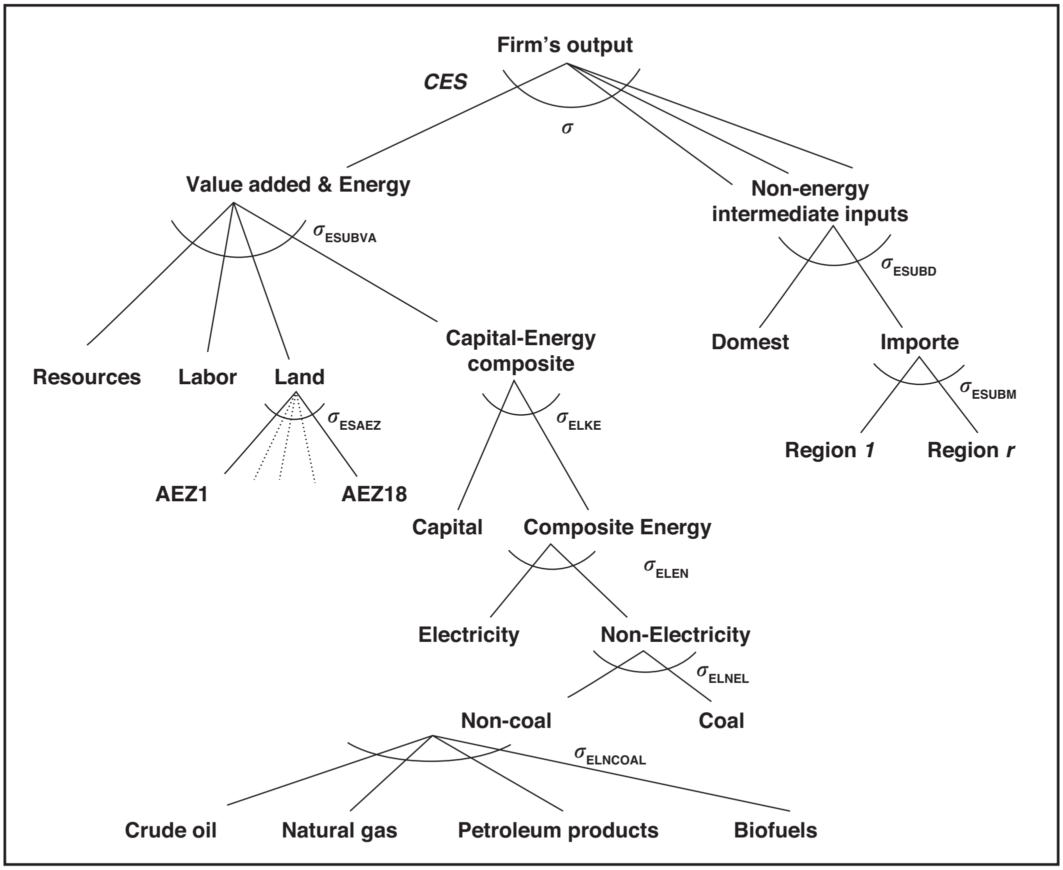
The macroeconomic analysis uses a static CGE model developed for Georgia (based on Global Trade Analysis Project data, 2011); see figure B.1.

There are three steps in this analysis, which provide one another with various inputs. First, the COED-provided estimates that are used for CGE simulations on mortality from air pollution and natural disasters, on IQ loss as a result of exposure to lead, and on natural disasters' damage to physical assets and crops are introduced into the CGE model to estimate their aggregate economic impact. Second, the outputs from the CGE model on estimated income and price changes because of environmental degradation are used in the poverty incidence analysis.

Based on the macroeconomic impact of environmental degradation, the study prioritizes across sectors (energy, transport, urban, and agriculture) a number of policy interventions that in the short term (2014–15) could support actions toward inclusive, efficient, clean, and resilient growth in Georgia.

The static CGE model/data (for 2011) for Georgia was developed by the GTAP at Purdue University in the United States (detailed documentation on the data and model is downloadable from the GTAP website). There 10 sectors/commodities. Each sector in the model is represented by different labor productivity rates. Two types of labor—skilled and unskilled workers—are represented in the model. Figure B.2 displays the production structure of the CGE model in which skilled and unskilled labor contribute to the value creation. Air pollution causes premature deaths, hence reducing the labor force, whereas exposure to lead implies a morbidity effect (workers' productivity decreases along with their incomes). Lower levels

FIGURE B.2. PRODUCTION STRUCTURE IN THE CGE MODEL



of incomes will negatively affect the purchasing power of households (figure B.3), hence reducing the demand for commodities/services. The magnitude of fall in demand for commodities/services would depend on the income and price elasticities for these. Elasticities come from the literature and are imbedded in the CGE model.

A drop in workers' incomes and price changes because of new demand and supply conditions for commodities lead to a welfare impact. A poverty analysis was undertaken outside the CGE model using the outputs of the CGE model to show the impact of the analyzed scenarios on the poverty headcount. Whereas the CGE model covers one representative household, the PE model was developed to estimate the distributional impact on several income groups.

Regarding the air pollution scenario, the main population at risk is urban skilled labor, which consists of some 47,360 employees, out of which 1.26 percent die prematurely because of high levels of $PM_{2.5}$. The number of premature deaths is deducted from the total number of available workers in the urban centers through a negative shock in the urban skilled labor force originally specified by the model data. The estimated annual GDP loss associated with ambient air pollution is about 0.48 percent of GDP.

Lead exposure scenario is specified as reduced workers' productivity. Because every adult was exposed to high levels of lead during childhood, the CGE model is used to estimate a loss of 1.6 percent in labor productivity for every worker (skilled and unskilled). The estimated annual GDP loss is 0.89 percent compared with an alternate scenario in which clean fuels would have been used in households for heating.

Regarding the natural disasters' scenario, the shock is designed as a damage on physical capital (first column in table B.1) and a loss in the value creation meaning in the GDP through a productivity shock (second column in table B.1). Loss of buildings over a 50-year period was applied to the baseline in 2012 in the CGE model as a one-time capital stock destruction, for which year the expected loss was calculated using a probabilistic method. The magnitude of the shock is equivalent to a loan that Georgia would need to take out to rebuild the destroyed capital asset (a 50-year loan at an interest rate of 3 percent).

FIGURE B.3. HOUSEHOLD CONSUMPTION STRUCTURE IN THE CGE MODEL

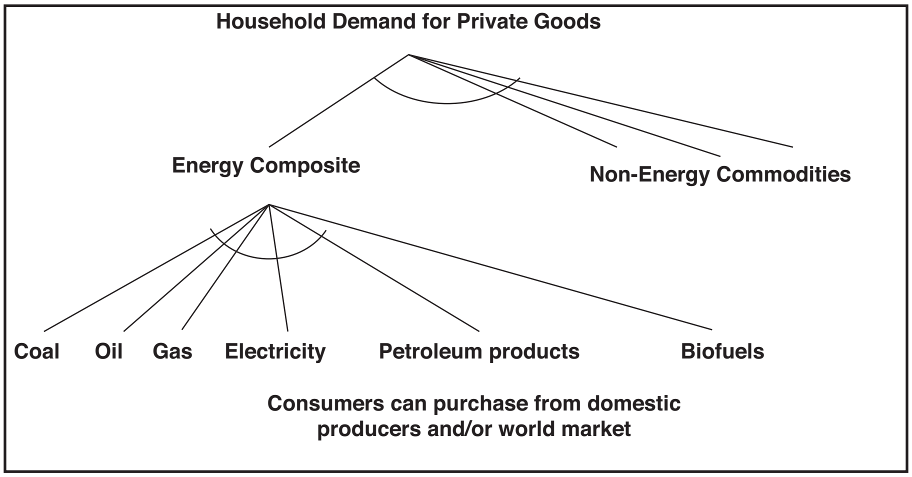


TABLE B.1. DESCRIPTION OF THE CGE SIMULATIONS' DESIGN

Simulations	Shock to the K Stock	GDP (%)
Buildings—$30,000	4.5	−1.88
Low magnitude	4.67	−1.95
High magnitude	4.98	−2.08
Buildings—$50,000	7.49	−3.15
Low magnitude	7.78	−3.28
High magnitude	8.29	−3.5
Loss in agricultural production		
Shock	2.29	−0.23
Low magnitude	2.37	−0.24
High magnitude	2.53	−0.26

The macroresults from the CGE analysis (mainly wages and income and price levels) are used as inputs in the poverty incidence analysis described in the next section.

C. POVERTY MICROSIMULATIONS

The microsimulations conducted in this report rely on the methodology proposed by Bourguignon and Ferreira (2005) and thoroughly applied in Olivieri et al. (2014). The main purpose of this exercise is to examine the potential distributional effects of a change in the GDP as a consequence of a major natural disaster. The methods applied allow the results obtained from the simulations performed to be linked with the CGE model (which are a concern of the economy at the macrolevel) with the information of household members' employment and income at the microlevel. All the simulations were conducted using the ADePT simulation module. Please refer to Olivieri et al. (2014) for a deeper overview of the method.

The methodology can be summarized in three steps, which are depicted in figure B.4.

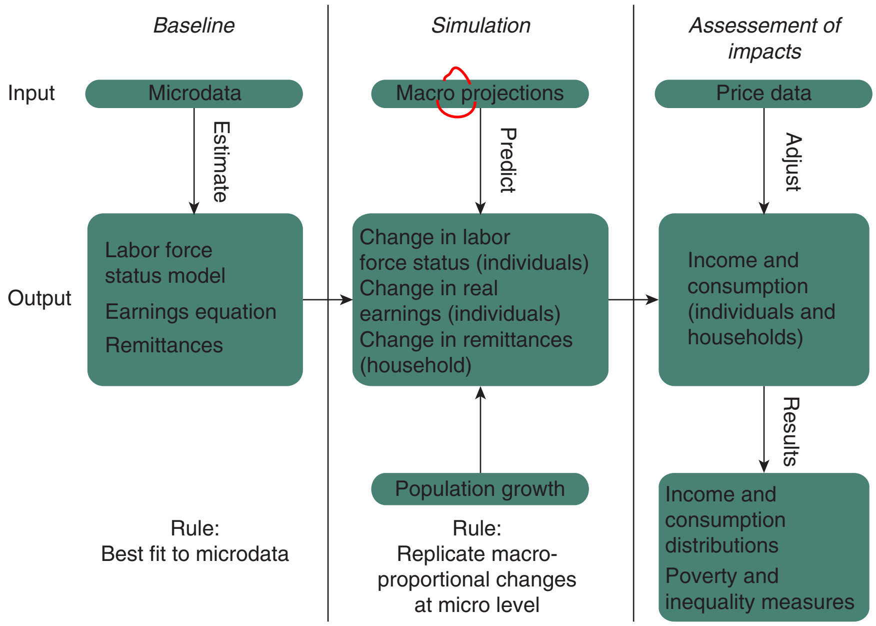
Step 1: Estimation of a behavioral household model on employment status, allocation, and earnings.

For this step, information from the latest household survey is required. We used data from the Integrated Household Survey (IHS) of Georgia from 2012 in our simulations.

This step is for the most part based on the estimation of an income generation model at the household level for the baseline year. In our case, we consider the year 2012 as baseline. Using the behavioral parameters estimated from the model at the baseline, it is possible to simulate the effect of changes at the macroeconomic level on economic variables at the microeconomic level.

Household income is made up of all the income earned by the household in a specific year from all labor and nonlabor income sources. With respect to the labor sources, labor income could be originated in different economic sectors of the economy. For our application, we will consider three sectors: agriculture, industry, and services. At the same time, whether a member of the household receives income from any of these economic sectors is conditional on two things: (i) the household member is an active member of the labor force, and (ii) the household member participates in one of the economic sectors. This distinction is important and will be emphasized below.

FIGURE B.4. DIAGRAM OF THE MODELING PROCESS



ED: close up macro and micro in fig

Source: Olivieri et al. 2014.

Nonlabor income sources are usually made up of public transfers (social assistance and pensions) and remittances.

Each of these components (labor-force participation, earnings, and nonlabor income) has to be jointly modeled in order to obtain estimates that will allow us to simulate the behavior of people. Thus, the household income generation model comprises three submodels:

a) Labor force participation model: The probability of participation in the three economic sectors (agriculture, industry and services) is estimated for each individual, as well as the probability of being out of the labor force. In our application, we do not differentiate between being nonactive in the labor force and being unemployed, because the CGE model used for the macrosimulations does not allow for this distinction. Individual and household characteristics are considered as explanatory variables.
b) Earnings model: Labor income for each individual is modeled considering household and individual characteristics as well as the probability of participation in each sector and the probability of being active in the labor force.
c) Nonlabor income model: This component is used to model the probability and amount of receiving remittances and/or public transferences. In our case, given the exogenous nature of the shock (natural disasters are not driven by any behavior originated at the macro- or microlevel), and the current allocation of public transfers in Georgia (the majority of households receive public transfers as pensions and/or social assistance), we do not consider any model on nonlabor income and we assume that it will not change in any of the scenarios considered for the simulations.

Step 2: Replication of the macrolevel shocks of the baseline into the target scenario.

Once the parameters of the labor allocation and earnings models are estimated in Step 1, it is possible to link the micro- and macroeconomic simulations. First, the participation equations are modified in order to match the labor allocations simulated at the macroeconomic level, based on the probability of each individual to participate in each sector. This exercise will provide a redistribution of the labor force in the three sectors taking into account the changes in the simulated macroeconomic variables. More specifically, the method searches for the allocation of individuals in the three sectors (and the "inactive" sector) that minimizes the difference between the employment and inactive rates in each sector observed at the micro- and macrolevels.

Once the employment rates at the micro- and macrolevels are matched and each individual is allocated to one of the three economic sectors (plus the "inactive" sector), the parameters estimated in the earnings equations are used in order to obtain new earning profiles in the simulated scenario. In order to do this, we first adjust the total predicted income obtained at the microlevel (considering the reallocation of employment) using the simulated sector-specific GDP growth rates obtained at the macroeconomic simulation. Then, the total income obtained in the population at the microlevel is rescaled to match the total growth in the economy, using the GDP growth rate.

Step 3: Calculation of the distributional effects of natural disasters

Recall that the data from the household survey in 2012 are used as a baseline. Then, using the results from the macroeconomic simulations in each scenario and the parameters estimated from the labor and earnings behavioral models, it has been possible to obtain a simulated distribution of individuals at the microeconomic level that have included the effects of a natural disaster in their decisions. Then, the calculations of the distributional effects rely on the differences between the simulated and baseline distribution. It is possible to calculate differences in poverty rates, but also differences of other indexes that rely on the entire distribution, such as shared prosperity and inequality indexes.

It is important to mention the assumptions considered in the simulations and their caveats. First, it is assumed that the inactive and unemployed population remains unchanged after a natural disaster has occurred. This has to be done to guarantee closure of the macroeconomic model. Thus, in the microsimulations, the share of inactive and unemployed population is fixed, even though the agents could switch from inactive to active because of changes in the economy. Second, the model relies on the structure of behavioral models built before the shock. Thus, the methodology assumes that these factors remain constant, and potential behavioral responses after the shock are not considered. The use of recent microeconomic data is important in order to ameliorate the effect of potential behavioral responses. Third, there are some disparities between the macroeconomic and microeconomic sectorial employment and level of skills shares. In order to be consistent with the microdata, the change in employed population in each sector and level of skills between the baseline and simulation was calculated at the macrolevel, and these changes were applied to the observed employed population in the household data. The risk of getting large disparities between the shares of employed population at the macro- and microlevels is that the changes on the assigned income to each sector could be misleading, even though the GDP simulations could be accurate. Finally, nonlabor income remains fixed to the baseline levels. No changes have been considered for public transfers given the event of a natural disaster.

APPENDIX C
GEORGIA'S LITTLE GREEN DATA BOOK STATISTICS

Population (millions) 4.5 Land Area (1,000 sq. km)	69 GDP ($ billions)		15.7
	Country Data	Europe & Central Asia Group	Lower Middle–Income Group
GNI per capita. *World Bank Atlas* method ($)	3,290	6,658	1,965
Adjusted net national income per capita ($)	3,065	5,541	1,574
Change in wealth per capita (2010 $)	–13	263	117
Urban population (% of total)	53.0	60.2	38.9
Agriculture			
Agricultural land (% land area)	36	66	46
Agricultural irrigated land (% of total agricultural land)	*4.0*	..	..
Agricultural productivity, value added per worker (2005 $)	2,512	4,866	938
Cereal yield (kg per hectare)	2,195	2,519	3,029
Forests and biodiversity			
Forest area (% land area)	39.4	10 .5	26.9
Deforestation (avg. annual %, 2000–10)	0.1	–0.5	0.3
Terrestrial protected areas (% of total land area)	3.9	5.1	11.9
Threatened species, mammals	10		
Threatened species, birds	11		
Threatened species, fish	9		
Threatened species, higher plants	0		
Oceans			
Total fisheries production (thousand metric tons)	12.7	1,022	43,067
Capture fisheries growth (avg. annual %, 1990–2012)	–9.3	–4,0	2.6
Aquaculture growth (avg. annual %, 1990–2012)	0.3	1.8	9.9
Marine protected areas (% of territorial waters)	64.5	10.4	14.7
Coral reef area (sq. km)	..	..	124,480
Mangroves area (sq. km)			58,917
Energy and emissions			
Epergy use per capita (kg oil equivalent)	790	2,078	687
Energy from biomass products and waste (% of total)	8.9	2.9	26.8
Electric power consumption per capita (kWh)	1,918	2.951	734
Electricity generated using fossil fuel (% of total)	22.6	65.8	72.3
Electricity generated by hydropower (% of total)	77.4	17.9	169
CO_2 emissions per capita (metric tons)	1.4	5.3	1.6
Water and sanitation			
Internal freshwater resources per capita (cu. m)	12,966	2,744	3,144
Total freshwater withdrawal (% of internal resources)	3.1	34.8	19.6
Agriculture (% of total freshwater withdrawal)	58	70	88

(continued)

Population (millions) 4.5 Land area (1,000 sq. km)	69 GDP ($ billions)		15.7
	Country Data	Europe & Central Asia group	Lower Middle–Income Group
Access to improved water source (% of total population)	99	95	88
Rural (% of rural population)	97	89	85
Urban (% of urban population)	100	99	94
Access to improved sanitation facilities (% of total population)	93	94	48
Rural (% of rural population)	91	90	36
Urban (% of urban population)	96	97	66
Environment and health			
Particulate matter (urban-pop.-weighted avg., µg/cu. m)	35	48	90
Acute resp. infection prevalence (% of children under five)	..	..	..
Diarrhea prevalence (% of children under five)	..	..	..
Under-five mortality rate (per 1,000 live births)	20	22	61
National accounting aggregates—savings, depletion and degradation			
Gross savings (% of GNI)	18.5	18.9	28.6
Consumption of fixed capital (% of GNI)	11.3	12.4	11.1
Education expenditure (% of GNI)	1.8	3.8	3.1
Energy depletion (% of GNI)	0.1	4.4	4.4
Mineral depletion (% of GNI)	0.2	0.6	1.1
Net forest depletion (% of GNI)	0.4	0.0	0.8
CO_2 damage (% of GNI)	0.4	0.8	0.9
Particulate emissions damage (% of GNI)	0.8	1.8	1.4
Adjusted net savings (% of GNI)	7.0	2.8	12.0

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