95408

Georgia

CLIMATE CHANGE AND AGRICULTURE COUNTRY NOTE

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This Country Note for Georgia is part of a series of country briefs that summarize information relevant to climate change and agriculture for three countries in the Southern Caucasus Region, with a particular focus on climate and crop projections, adaptation options, policy development and institutional involvement. The Note series has been developed to provide a baseline of knowledge on climate change and agriculture for the countries participating in the **Regional Program on Reducing Vulnerability to Climate Change in Southern Caucasus Agricultural Systems**. This note for Georgia was shared with the Government and other agricultural sector stakeholders and used as an engagement tool for a National Awareness Raising and Consultation Workshop, held in Tbilisi in April 2012. Feedback and comments on the Note from this consultation process have been incorporated into this updated version in collaboration with the Georgian Ministry of Agriculture.

Climate Change Exposure and Risk for Georgia

Georgia is especially vulnerable to climate change, with 52.3% employment in agriculture and 8% of total GDP in agriculture in 2010.[1] Agriculture is a highly climate-sensitive sector, and therefore Georgia's rural population and their livelihoods are vulnerable to climate change. Georgia is a mountainous country with diverse physical geography and climates, has a history of shortage of potable water, and experiences natural disasters, making the nation particularly susceptible to global environmental changes.[2] Additionally, 9.7% of the nation lives under the national poverty line.[31] Currently available climate projections indicate that Georgia will be exposed to:

- Mean annual temperature increase 3.5°C in West Georgia and 4.1°C in East Georgia by the end of the century,[4] with a range from 1.3°C to 2.8°C in 2050;[33]
- Precipitation decrease of 6% in West Georgia and of 14% in East Georgia by the end of the century,[4] but the forecasts vary by month and by climate model;[33]
- Reductions in streamflow of 26 to 35% in the Alazani (Ganikh) Basin, and reductions in streamflow of 9-11% in the Khrami-Debed Basin by 2100.[6]
- Increased degradation of steppe ecosystems in the lowlands, upward shift of forests, expansion of invasive species, and increased frequency of extreme natural phenomena;[4]
- A more marginal and risky agricultural production environment, as increases in temperatures and reduced precipitation during critical crop and pasture growth periods could cause a large moisture deficit; and
- An increased exposure to new pests and diseases for agricultural crops, forests and livestock due to temperature increases.
- Climate change will create risks for the sector, but also opportunities – both need to be carefully assessed.

In this Note

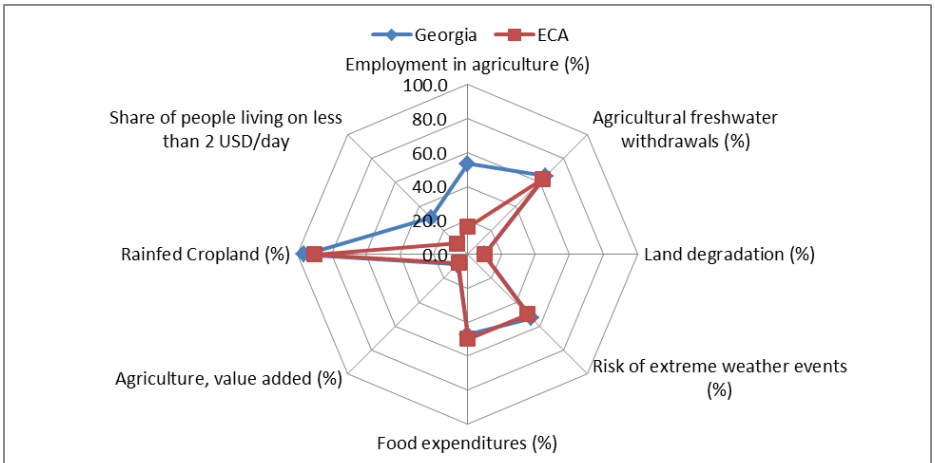
Georgia at a Glance

(World Development Indicators 2012 and GeoStat 2011)

Population	4.45 million
Population below the poverty line	9.7%
GDP	11.67 billion USD
GDP Per Capita	2,620 USD
Agriculture as a % of GDP	8%

I. Introduction

Some work has been done to address climate change in Georgia and in the Southern Caucasus region. Georgia, as a transitioning country (Non-Annex 1), has submitted two National Communications to the United Nations Framework Convention on Climate Change.[2] Climate change is an essential issue for political security in this region due to the exacerbation of droughts, the potential for shortages of high quality water for drinking or irrigation processes, and soil degradation. The region is already experiencing the effects of the changing climate on nature and on its people. However, private capital investment in Georgia increased by 4.6 times from 2004 through 2007, which has helped the region's economic revival. Since then, Georgia has experienced major losses due to the military conflict in August 2008, especially in agriculture, manufacturing, trade, tourism, transportation, construction, and banking.



Sources and Notes:
1. Employment in agriculture (% of total employment) based on World Development Indicators for 2008.
2. Agricultural freshwater withdrawals (% of total freshwater withdrawals) based on World Development Indicators for 2009.
3. Land degredation (% of total land) based on FAO TERRASTAT data for 2005.
4. Risk of extreme weather events is calculated as the number of additional weather events in 2070-2090 relative to 1961 to 1990 divided by 19, the number of possible number of additional extreme weather events. See Baettig, M. et al. (2007), "A Climate Change Index: Where Climate Change May Be Most Prominent in the 21st Century", *Geophysical Research Letters*.
5. Food expenditures (% of total expenditures) based on data from Laborsta (laborsta.ilo.org) for 2003.
6. Agriculture, value added (% of GDP) based on World Development Indicators for 2010.
7. Rainfed cropland (% of total agriculatural land) is calculated as (1 - % of irrigated agricultural land). Data on irrigated land as a %

Figure 1: Georgia Vulnerability Indicators

The economy is further weakened due to the diversion of funds toward helping thousands of homeless Internally Displaced Persons as well as decreased purchasing power.[4] The southern Caucasus region continues to experience insufficient access to safe drinking water, especially in Armenia and Georgia. The expected changes in climate, such as a rising temperature, limited water availability, increasing frequency and magnitude of extreme weather events, and sea level rise and associated coastal erosion will impede development in the region. Integrating climate change adaptation and mitigation into development goals will help reduce impacts from such climatic changes.[7]

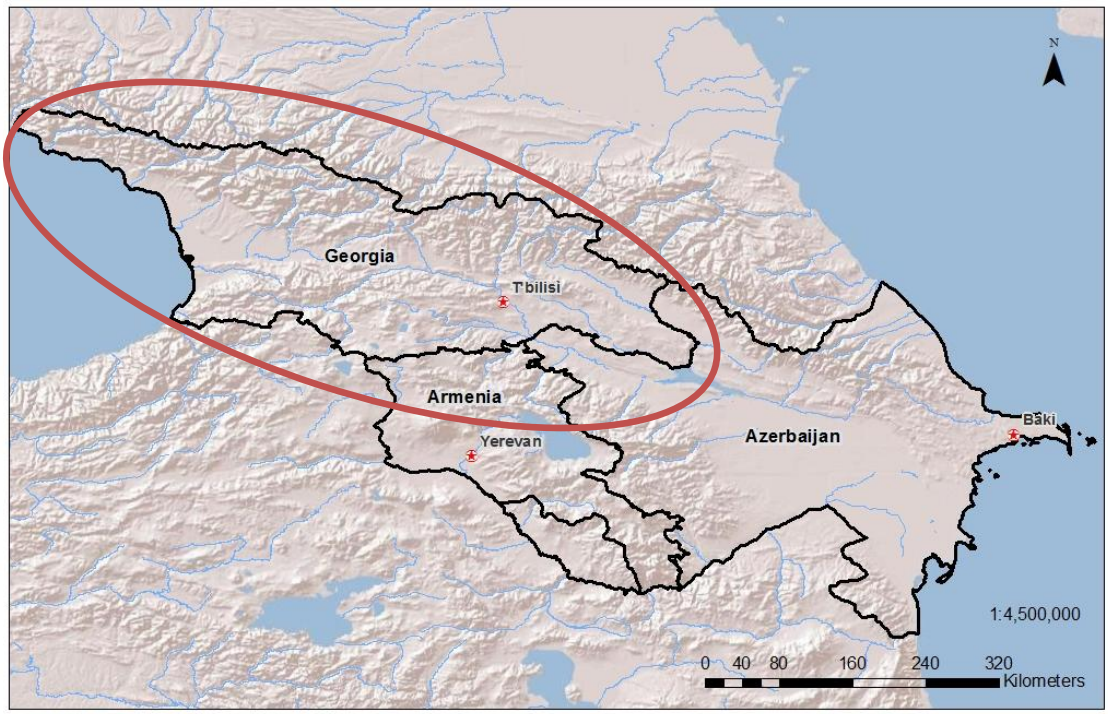


Figure 2: Relief Map the Southern Caucasus
Source: ESRI Online and IEc analysis

Agriculture is of central importance to Georgia, accounting for a large portion of employment, rural growth and livelihood, food security, and exports. However, the sector is highly sensitive to adverse changes in climate-related conditions such as temperature, precipitation, and frequency of extreme events (e.g. droughts/floods, storms). The country is particularly vulnerable to natural hazards including floods, earthquakes, droughts, landslides, avalanches, debris flows and mud flows.[32] From 1995 through 2009, floods and erosion, particularly through landslides and mudflow, led to 650 million USD in economic losses.[6] Increased extreme events are apparent in the frequency of floods doubling from the first half of the period between 1967 and 1989 to the second half of the period and, over the same period, floods lasted 25% longer.[4] The effects of such changes may augment existing inequalities between rich and poor populations in vulnerable communities by threatening Georgia's institutions, food supply, and rural growth. Additionally, the country's financial position and institutional capacity to respond to natural climate hazards may not be strong enough to protect sustainable agricultural production and stimulate rural development.

Figure 1 displays eight climate change vulnerability indicators and compares Georgia to the Europe and Central Asia (ECA) Region average for transition economies. Although Georgia is near the ECA average for several indicators, Georgia has a considerably larger share of its population employed in the agricultural sector and a larger share of its population living in poverty. European countries have an average of just 4.5% of the population employed in agriculture as compared to 52.3% in Georgia, and the average GDP derived from agriculture for high-income European countries is significantly lower than in Georgia at just 2%.[1] Additionally, 9.7% of the Georgian population lives under the national poverty line.[31] These statistics indicate that the Georgian people are particularly vulnerable to climate change.

Geography

Georgia is a small country, roughly 69,700 km^2 in size.[4] As can be seen in Figure 2, Georgia is bordered by Russia to the north and east, Azerbaijan to the southeast, Armenia and Turkey to the south and the Black Sea to the west. It is divided into nine regions, two autonomous republics, and Tbilisi, the capital city.[7] Mountains cover roughly 54% of the country while highlands and valleys compose the other 33% and 13%, respectively. About 70% of the country is below 1,700 meters above sea level, an elevation which supports agriculture, while in general only pastures exist at higher altitudes.[9] Georgia's geography is diverse, with humid subtropical lowlands and wetlands, plains, semi-deserts, highlands, mountains covered by forests and glaciers, lakes and many rivers.[4] The Likhi Mountain Range serves as a geographical barrier, dividing the country into eastern and western halves.[4] The Greater Caucus Mountain Range spans northern Georgia and the Lesser Caucus Mountains stretch across southern Georgia. The lowlands in the western portion of the country consist mostly of wetlands while the lowlands in eastern Georgia are dry. Georgia is generally rich in fresh water with rivers, lakes and springs. Its largest river is the Mtkvari (Kura), which originates in Turkey and flows through Georgia to the Mingechaur Reservoir in Azerbaijan.[4] See Figure 3 for more details.

Total area	Agricultural area	Forest area	Mountainous area (over 1,000 m)	Fresh waters (lakes, rivers, reservoirs)	Wetlands	Glaciers	Semi-deserts
69,700 km^2	30,258 km^2	24,562 km^2	37,640 km2	8,351 km^2	600 km^2	511* km^2	70 km^2

** Based on 1960 data; latest estimates indicate that this area has been decreased to about 400 km^2*

Figure 3: Georgia's Geography
Source: UNFCCC Second National Communication

Demography

Georgia has a population of around 4.47 million[31] with about 47% of the people living in rural areas as of 2010.[8] Life expectancy for children born in 2009 is 73 years.[1] The population is slowly declining at a rate of -0.32% due to a high rate of migration (4.36 per 1,000 capita) rather than the birth/mortality ratio (10.62 births and 9.51 deaths per 1,000 capita).[4] The proportion of the population living in rural versus urban areas has been relatively constant.[1] About 9.7% of Georgians live at or below the national poverty line.[31] The poorest of these people spend up to 65% of their income on food and are therefore highly sensitive to changes in food prices.[8]

II. *Agriculture*

Agriculture plays an important role in Georgia: roughly 43% of Georgia's land is cultivable, although much of this land is degraded and no longer used for agriculture.[4] The breakdown of land area in Georgia is displayed in Figure 4. In 2009, there were about 300,000 ha of land cultivated for annual crops, about 120,000 ha in permanent crops, and almost 2 million ha as permanent meadows and pastures.[9]

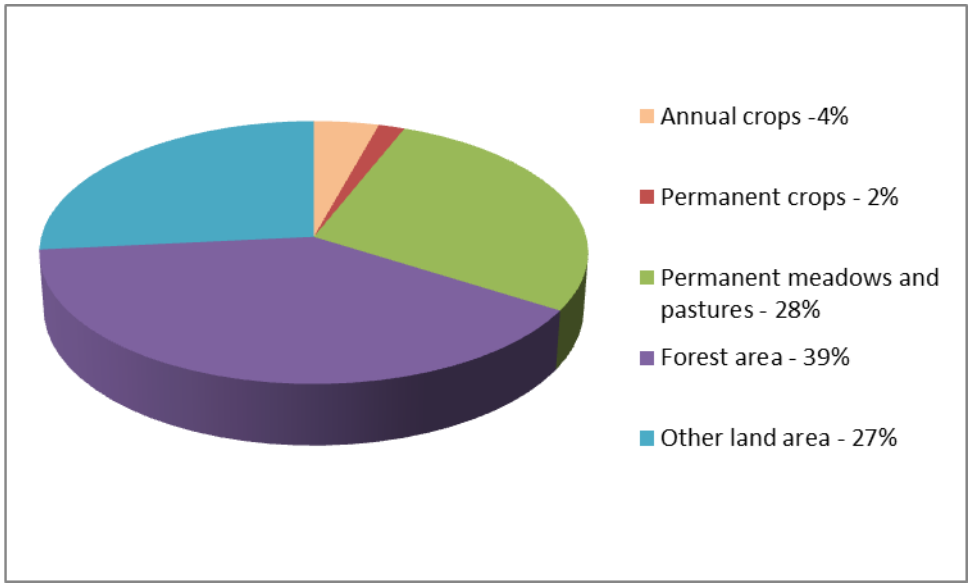


Figure 4: Land use in Georgia,
Source: FAOSTAT. ResourceSTAT.

Grains (wheat and maize), fruits, grapes, citrus plants, berries, nuts, tea, potatoes, and tobacco are all common crops (see Figure 5 for some available data),[10] while cattle and sheep are the most common types of livestock.[4] The agricultural products with the highest production value in 2009 were cow milk, grapes, cattle meat, and hazelnuts (see Figure 6 for available data).[11]

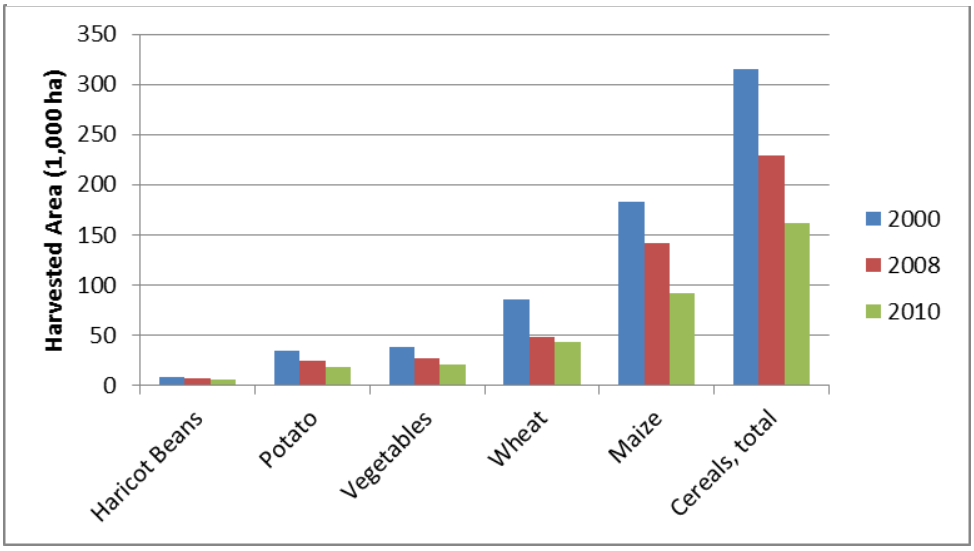


Figure 5: Area Harvested by Crop in Georgia
Source: GeoStat

The establishment of agriculture as an important part of the Georgian economy is largely due to a historically high soil fertility, although degradation of land is a major issue limiting agricultural production in the current situation.[4] After 1992 agricultural lands were distributed to rural families, although it wasn't until 1996 that these transfers technically became legal. Between 80 and 90% of the newly created farms were less than one hectare in area. As a result, the agricultural sector is relatively fragmented, inefficient, and with limited access to capital and machinery.[12] Although some privatization has taken place, this process is not yet complete. Of the roughly 3 million hectares of land used for agricultural purposes, private farmers own just 23% while 10% has been leased to farmers and the remaining 67% is owned by the state. The majority of state-owned agricultural land is not cultivated because of complex topography, poor soil, separation from populated areas, and damaged irrigation and drainage systems.[13]

Reductions in planting area are seen in Figure 5, which shows area harvested of relevant crops in the country. Decreases in gross production can also be seen in Figure 6 across all crops from 2000 to 2010, though there are higher production levels in some crops, such as cereal and maize in 2008. Additionally, from 2006 to 2010, the number of cattle, pigs, and sheep and goats declined by 2%, 74%, and 30%, respectively.[31] Other agricultural issues that played a role in the decrease in output include water and wind erosion, environmentally-degrading agricultural practices, and other anthropogenic and natural processes that caused the degradation of 35% of farmland.[13]

Overall trends in area harvested and production have declined not just in the previous two years but over the past decade. Land area devoted to harvesting cereals fell 55% from 2001 to 2010, with a sharp decline of 40% between 2005 and 2006. Vegetable crops underwent a similar trend with an overall decline of 46% in area harvested from 2001 to 2010; virtually the entire decline occurred in 2006. The trend in production mirrored that of area harvested for these three major crop types. Cereals and vegetables faced 73% and 68% declines, respectively, in production from 2001 to 2010, with sharp decreases in productivity of 54% and 59% from 2005 to 2006.[31] Drops in output are not part of a general trend, but can be explained by a combination of several adverse events. For wheat and maize, it was a result of reduced planting area, unfavorable weather, pests, disease, and poor agricultural practices.[8]

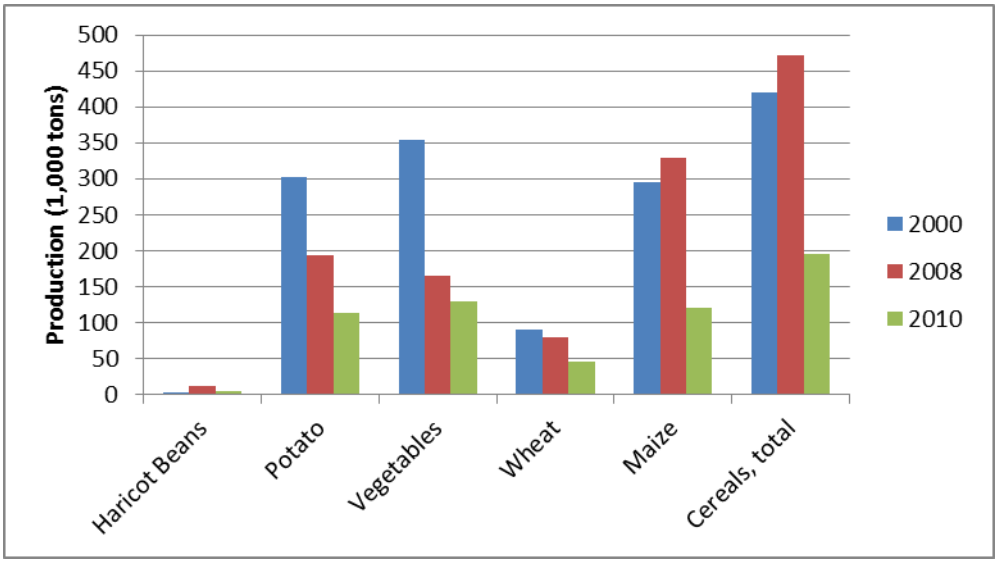


Figure 6: Production by Crop in Georgia
Source: GeoStat

III. *Agriculture and the Adaptation Deficit*

The sensitivity of the agriculture sector to climate has important implications in Georgia. With 9.7% of the population under the poverty line,[31] 52.3% of employment in the agricultural sector[1], and 47% of the population living in rural areas[8], rural communities are especially vulnerable and at risk from any changes that occur as a result of climate change. This risk is further exacerbated by the relatively low productivity associated with a lack of adaptive capacity to the present climate, also known as adaptation deficit. This is best illustrated by a comparison of wheat yields from other countries in the region, as displayed in Figure 7. For example, the average wheat yields 2007-2009 for Georgia are 21% of those in Western Europe.[11] This underperformance can be attributed to a complex set of factors, including distortions and imperfections in agricultural output and input markets; poor quality public services in areas like agricultural education, extension, research, and market information systems; delays in farm restructuring and undeveloped agricultural land markets; lack of access to finance; unsustainable management of soils; insufficient or inefficient irrigation; and high vulnerability to natural hazards like droughts, floods, frosts, and severe storms. Some of these factors are directly linked with climate and the adaptation deficit – others are associated with a low level of economic development in the sector, but if addressed they would also improve the sector's adaptive capacity. The challenges created by this unfavorable environment for agriculture will increase significantly as a result of climate change. It is therefore fundamental that action should be taken to address the adaptation deficit as part of any climate change adaptation strategy.

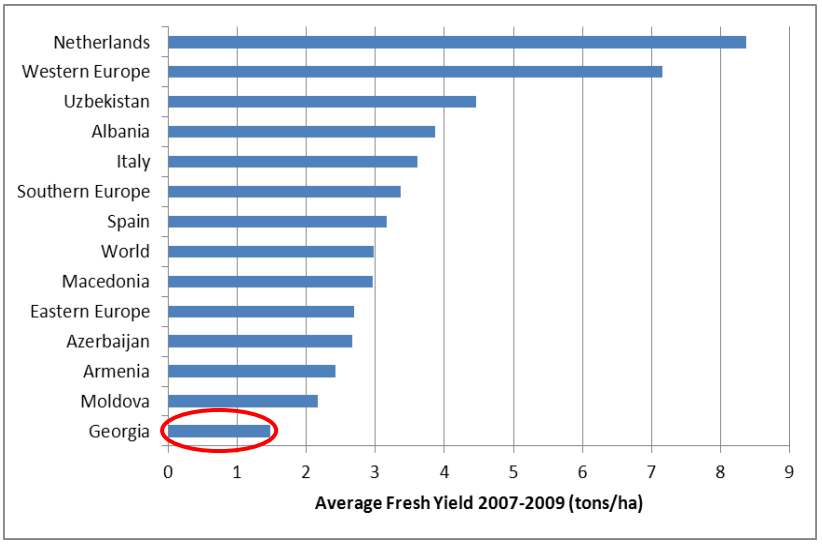


Figure 7: Average Wheat Yields in Select Countries, Averaged from 2007-2009
Data Source: FAOSTAT

IV. *Agriculture and the Economy*

Agricultural GDP grew approximately 35% from 2000, to 2010, but the share of agriculture in Georgia's overall GDP fell from 22% of 3.1 billion USD in 2000 to 8% of 11.7 billion USD in 2010. Agriculture employs 52.3% of the labor force which has been relatively constant over time.[1] The sector is not efficient, with labor productivity in agriculture half that of economy as a whole.[12,5] Between December 2010 and March 2011, food prices throughout the country increased by 10%. Specifically, bread, potato and beef prices increased by 8%, 14% and 25% respectively.[8]

Gradual commercialization of agriculture is occurring where agricultural production was previously small-scale. Of the 3 million ha of agricultural land, about 0.7 million ha are owned and cultivated by private farmers, 0.3 million ha are leased to farmers, and 2 million ha are still owned by the state and are generally not cultivated. In 2005, 1.07 million hectares were cultivated.[10]

To avoid further decline in agricultural production, Georgia is planning to augment seed distribution and require payment only after crops have been harvested. They are also planning to support storage infrastructure in order to promote local production and lengthen the marketing season for local high value and cereal crops. The national government has approved an 80% increase in the budget for agriculture in 2011 compared to 2010 and will mobilize an additional 89.9 million USD for investment in the sector.[8]

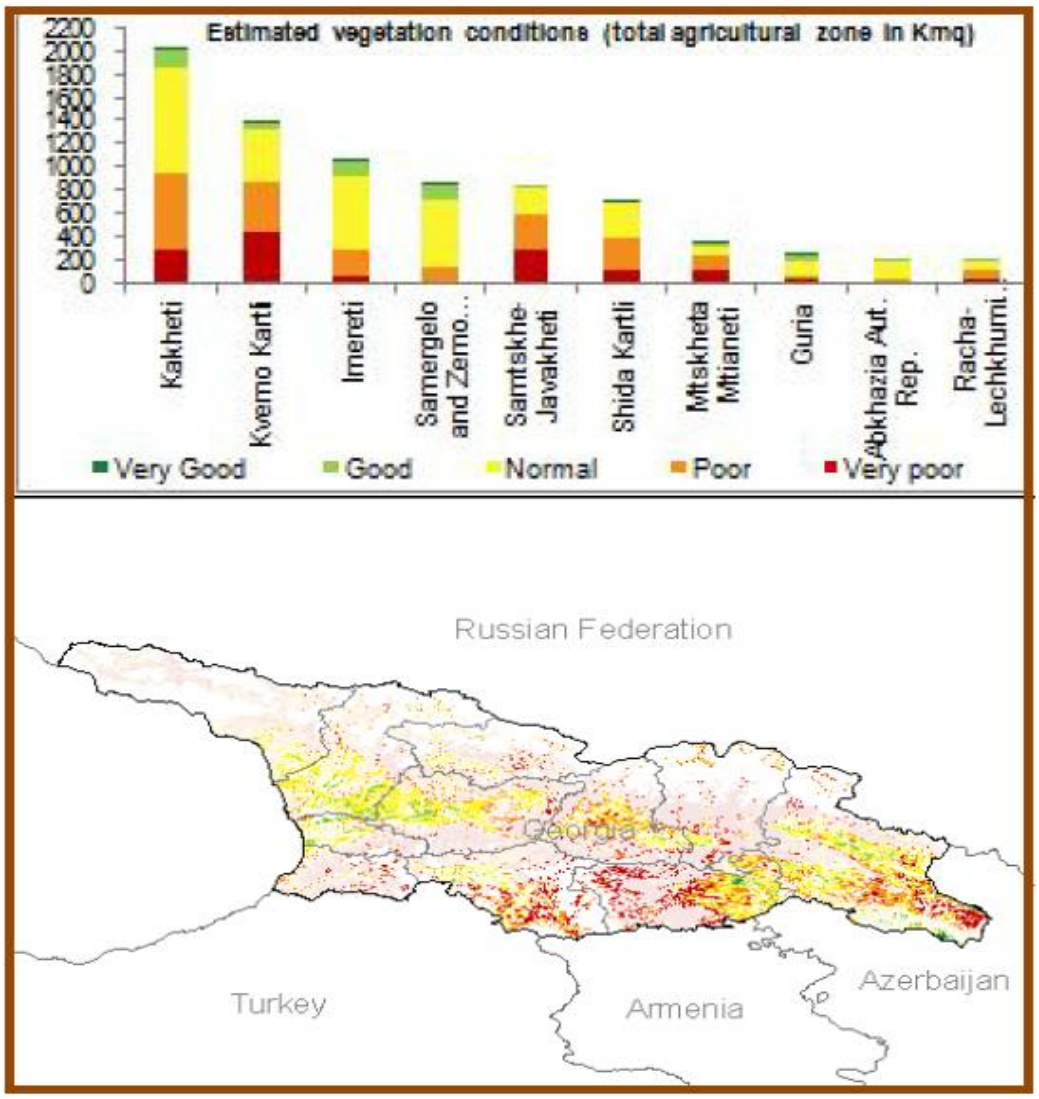


Figure 8: Estimated vegetation conditions
Source: FAO Highlights

Georgia and the European Union (EU) have had relations since 1992. The EU assisted Georgia through the preliminary transition years, and, during the "Rose Revolution" in 2003, the EU said they would back Georgia's commitment for economic, social and political reform. The EU-Georgia relationship is strengthened by the Partnership and Cooperation Agreement (PCA), which began use in 1999 and is now extended automatically on an annual basis. The PCA includes cooperation in political dialogue, trade, investment, economic, legislative and cultural cooperation. In 2003, with the European Union Special Representative for the South Caucasus, the EU set out to more actively contribute to conflict resolution in the South Caucasus and strengthen relations with Georgia, Armenia and Azerbaijan. Additionally, in 2006, the EU-Georgia ENP Action Plan defines strategic objectives of the partnership (Delegation of the EU to Georgia).

V. *Agriculture and the Environment*

Some of the most pressing environmental issues are air pollution, heavy pollution of the Mtkvari River and the Black Sea, lack of sufficient potable water, and soil pollution from toxic chemicals.[14] Poor soils are most prevalent in the eastern portions of the country where overgrazing and reduced precipitation have led to wind erosion. In many cases, lands either lack the necessary irrigation to be productive or are irrigated but suffer from issues that stem from the irrigation such as waterlogging and salinization. Salinization is especially problematic, affecting 20 to 40% of all land in Georgia – as a result, much of this land is no longer in agricultural production.[12] Overall vegetation conditions across Georgia are mapped in Figure 8. Human-induced degradation represents a fairly small portion of land degradation compared to other countries, as is seen in Figure 9. Agriculture accounts for all human-induced land degradation in Georgia, as opposed to accounting for only 23% of human-induced degradation across Europe.[15]

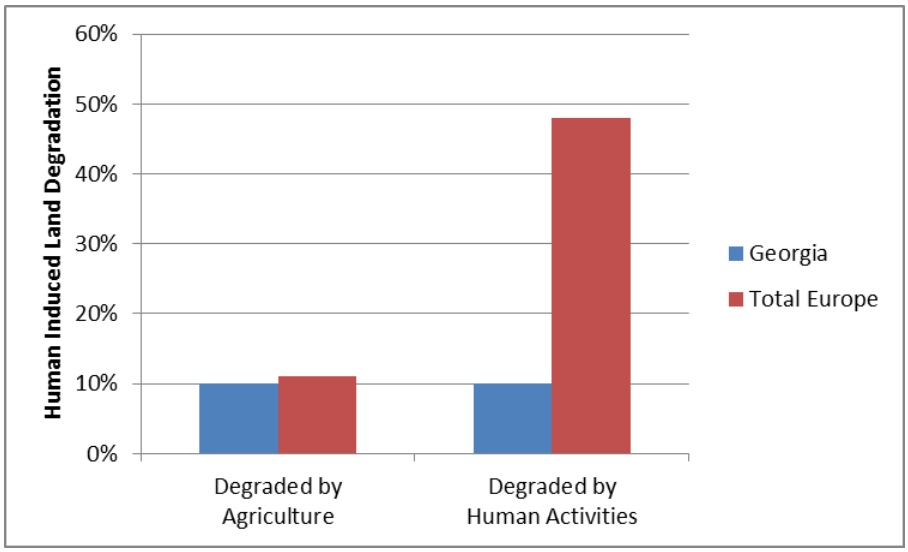


Figure 9: Land Degradation by Type, as a Percent of Total Land Degradation
Sources: FAO Land and Water Development Division TERRASTAT http://www.fao.org/ag/agl/agll/terrastat/

Although the importation of fertilizer declined from 200,000 tons in 1989 to 60,000 tons in 2005, the use of manure collected from animals also experienced a significant drop over the same period of time.[12] As a result, negative environmental impacts from the use of nitrogen, potassium, and phosphorus fertilizers have decreased. Similarly, pesticide use has declined but still negatively impacts the environment because pesticide operators are not licensed and trained regularly and there is widespread use of inadequate storage and dumping facilities.[12]

Together, these problems have generally reduced the fertility of soil in Georgia. About a third of the 3 million ha of agricultural land is affected by soil erosion, 11% is affected by acidity, nearly 7 to 8% is affected by waterlogging due to malfunctioning drainage systems, 5.1% is affected by excessive potassium and nitrates, and about 7% is affected by salinity.[12]

Climate is also showing impacts on agriculture in Georgia. Wheat development has benefitted from increased precipitation during the winter and early spring, however, warm weather following a rainy and cool climate can lead to wheat leaf rust outbreaks in the major wheat growing areas (Kakheti and Kvemo Kartili). This suggests a need for crop protection measures. Potatoes have also benefitted from high precipitation levels, especially in spring of 2011. Extreme events, potentially impacted by climate change, are affecting Georgia's economy. From 1995 through 2009, floods and erosion, particularly through landslides and mudflow, led to 650 million USD in economic losses.[6]

VI. *The Climate Context*

Climate Description

The climate in Georgia varies substantially with location, from humid subtropical to permafrost. Variations in landscape, relating to these variations in climate are shown in Figure 10. On the West coast region along the Black Sea, the climate is humid and subtropical, where the average temperature is 14°C to 15° C and extremes range from -15°C to 45°C, with annual precipitation between 1,500 mm and 2,500 mm. The influence of the Black Sea leads to mild winters, hot summers, and large amounts of precipitation. In the mountainous parts of the country, average air temperature ranges from 2-4°C to 6-10°C with a minimum of -30°C to -35°C, and annual precipitation from 1,200 mm to 2,000 mm.[4] Many climate studies also predict longer periods of extreme temperature, heavy precipitation, and drought. These issues are pertinent to agricultural production, but are difficult to forecast using the results of global climate models.

The climate in the East is also complex. The plains in eastern Georgia make up lowlands with a dry subtropical climate and a mountainous area that has an alpine climate. The average temperature is 11 to 13°C in the plains, and 2 to 7°C in the mountains, with a minimum of -25°C and -36°C, respectively. Temperature in the high mountains ranges from -42°C to 42°C. Annual precipitation is 400 to 600 mm in the plains, and 800 to 1,200 mm in the mountains.[4] Due to Georgia's cumulative temperatures, sunshine hours, and growing days, agriculture has a high potential for high value annual and perennial crops such as grapes, fruits, tea, citrus, vegetables, tobacco, and medicinal plants.[12]

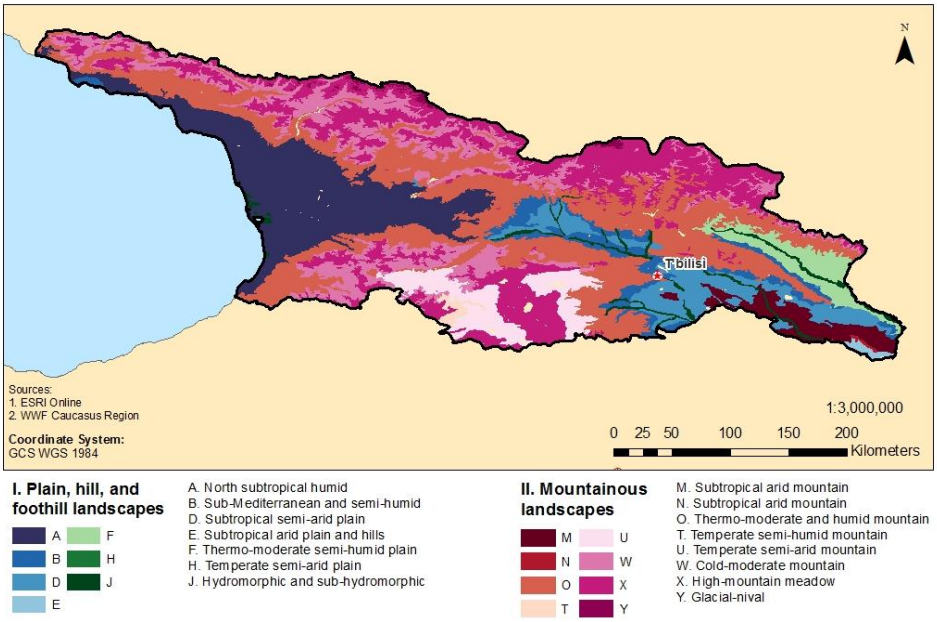


Figure 10: Climate Zones of Georgia
Sources: ESRI online, WWF Caucasus

Georgia can be divided into four agricultural zones based on elevation, temperature, and precipitation (see Figure 11). The four zones are the Eastern lowlands, Western lowlands, Eastern mountainous, and Western mountainous regions. Irrigation is concentrated mainly in the two lowland regions of the country. These zones are largely consistent with the climate zones of Georgia depicted in Figure 10.

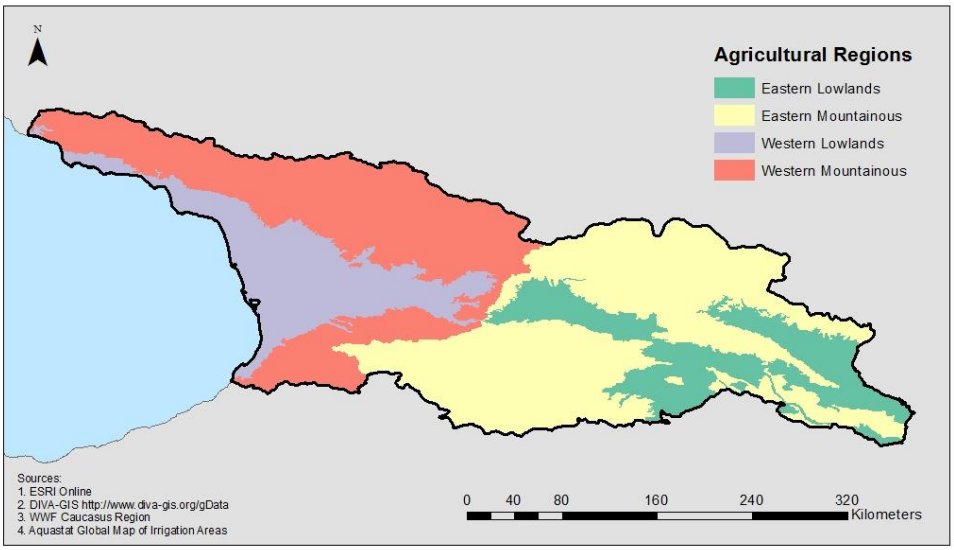


Figure 11: Agricultural Zones of Georgia
Sources: ESRI online, DIVA-GIS, WWF Caucasus Region, and author analysis

Historical Climate Trends

Changes in climate in the Southern Caucasus region seen thus far include: increasing temperatures, shrinking glaciers, sea level rise, reduction and redistribution of river flows, decreasing snowfall, and an upward shift of the snowline. In the past ten years the region has also experienced more extreme weather events with flooding, landslides, forest fires, and coastal erosion which resulted in economic losses and human casualties.[7] The Second National Communication reports climate trends in the period 1955 to 1970 and the period 1990 to 2005. The three most vulnerable regions in Georgia in terms of changes in climate between these periods are the Black Sea coastal zone, the Dedoplistskaro region and Kvemo Svaneti, which all experienced an increase in both temperature and precipitation between periods. The Second National Communication aggregates climate records over these periods to determine historic changes in temperature and precipitation as follows. In the western portion of the country, from the first to the second time period, the mean temperature increased 0.2 to 0.4°C and precipitation increased 8 to 13%. Similarly, in eastern Georgia, temperature increased 0.6°C and precipitation increased by 6%. These changes were experienced in both the winter and summer seasons.[4] Spatial variability in temperature and temperature trends are shown in Figure 12; and climate variables in the three most sensitive regions are displayed in Figure 13. Along with increasing temperatures, the glaciers are melting rapidly in the region, as they are globally. The volume of glaciers in the Caucasus has been reduced by 50% over the last century.[16] In Georgia, glaciers are retreating 5 to 10 meters per year, with a maximum of 25 meters per year. Irregular rainfall patterns lead to heavy downpours which result in flooding and large economic losses (Gobejishvili). In Georgia,

warm temperatures and sudden seasonal snow melt led to flooding across the country, including landslides and mudflows in many mountain areas in April and May 2005. This resulted in loss of infrastructure and homes, and created health, sanitation, food, and water problems, with a total cost of millions of U.S. dollars.[17] Extreme climatic variables are also noted in extreme temperature trends. An increasing trend in the number of days per annum with maximum temperature over 25°C are noted in over half of the stations monitored, while no trends were found in the remaining stations. Additionally, an increasing number of days per annum with daily minimum temperatures over 20°C were observed in over a quarter of the stations analyzed, where the rest had no significant trends.[6]

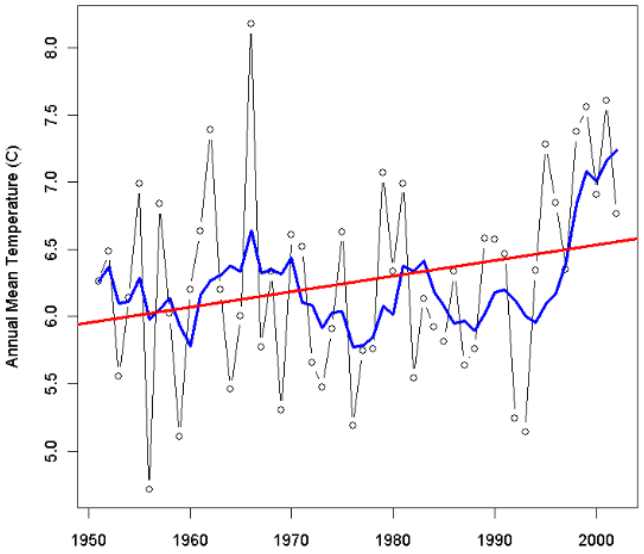


Figure 12: Average Annual Temperature 1951-2002
Produced by ClimateWizard © University of Washington and the Nature Conservancy, 2009. Base climate data from the Climate Research Unit (TS 2.10), University of East Anglia, UK, http://www.cru.uea.ac.uk

Priority region (meteorological station)	Average values of mean annual air temperature for respective periods (˚C)			Average values of annual sums of precipitation by period (mm)				Average value of air temperature absolute minima (˚C)			Average value of air temperature absolute maxima (˚C)			HTC
	I	II	II-I	I	II	II-I	II-I (%)	I	II	II-I	I	II	II-I (%)	II-I (%)
The Black Sea coastal zone (Poti)	14.4	14.6	0.2	1837	2078	241	13	-13.0	-10.0	3.0	33.8	35.4	1.6	+0.6 (20%)
Kvemo Svaneti (Lentekhi)	9.6	10.0	0.4	1256	1360	104	8	-14.5	-13.8	0.7	34.7	35.2	0.5	+0.6 (28%)
Dedoplistskaro region (Dedoplistskaro)	10.6	11.2	0.6	586	622	35	6	-11.5	-11.5	0.0	32.7	34.8	2.1	-0.2 (-15%)

Designation of periods: I - (1955-1970); II - (1990-2005)

Figure 13: Change of Climatic Elements in Priority Regions, 1955-2005
Source: UNFCCC Second National Communication

Georgia's coastal region, in the western agricultural zone, is expected to be the most vulnerable part of the country to climate change. The mean rate of sea-level rise on the eastern coast of the Black Sea was 2.6 mm per year over the last century, and is expected to accelerate in the future. Additionally, the frequency of powerful storms (force 5 to 7) has increased by three times in Poti and Batumi during the past four decades, and there has also been an increase in maximum wind velocity.[4]

The Dedoplistskaro region, at the eastern tip of Georgia and within the eastern agricultural zone, has also been identified as an area vulnerable to climate change because of the possibility of land degradation. Extreme weather events such as drought and high winds are negatively affecting agriculture, which is the only developed economic sector in the region. Climate change has increased the severity of these events over the past 50 years. Over this time, the annual duration of the drought period has increased from 54 to 72 days, and the frequency of drought occurrence has doubled. The frequency of high winds (speeds greater than 30 m/s) is five times greater than at the beginning of 1980s.[4]

Kvemo Svaneti, a mountainous region along the central portion of the Georgia's northern border in the central agricultural zone, is the third region that is most vulnerable to climate change. Disastrous weather events, including floods, landslides and mud torrents, are becoming more and more common. Increased frequency and intensity of these phenomena causes land erosion which impacts agriculture, forests, roads and communications. Over the past 50 years, mean air temperature has risen 0.4°C and precipitation has increased 106 mm (8%). Increased extreme events are apparent in the frequency of floods doubling from the first half of the period between 1967 and 1989 to the second half of the period and, over the same period, floods lasted 25% longer. Landslides increased by 43% since 1980 and both mud streams and droughts have become much more frequent as well. Additionally, the duration and recurrence of droughts have increased by 38%

and 17%, respectively since 1991 compared to the period 1956 to 1972. The occurrences of pests and diseases in forests of the region, which cover 60% of land area, have increased over the past 15 to 20 years. The Central Caucasus glaciers of this region have decreased in area by 25%, and in volume from 1.2 km^3 to 0.8 km^3. Increasing temperatures might cause the glaciers of this region to disappear by 2050.[4]

Climate Projections

The Second National Communication forecasts two scenarios of climate change. In West Georgia, the model predicts an increase in mean annual temperature of 3.5°C and a 6% decrease in precipitation by the end of this century, while in East Georgia, the model predicts an increase in temperature of 4.1°C and decrease in precipitation of 14% by the end of the century.[4] Temperature and precipitation changes through 2100 from the Providing Regional Climates for Impact Studies (PRECIS) and MAGICC/SCENGEN, two models that evaluate climate scenarios, are shown in Figure 14. World Bank analyses, relying on a broader range of climate models, indicate temperature increases could range from 1.4°C to 2.8°C in 2050.[33]

These changes in climate could increase aridity, which could change local semi-arid landscapes into arid semi-desert and desert landscapes in the Dedoplistskaro region. The Alazani and Iori Rivers, the main water suppliers of the territory, could potentially experience an 8% and 11% decrease in the annual runoff, respectively, from 2071 to 2100.[4] Some ecosystem changes expected to occur with climatic shifts include: degradation of steppe ecosystems in the lowlands with increasing temperatures in the East; upward shift of forests in the Eastern portion of the Greater Caucasus by 150 to 180 meters, which will reduce the alpine vegetation zone; upward shift of ecosystems in South Georgia by 150 to 200 meters at the expense of certain forest types and alpine systems; altitudinal change of the relict Colchic forest systems in southwest Georgia and expansion of Mediterranean types of lowlands; and expansion of introduced and invasive species in a belt from the west to the east.[7]

Region	Season	Spring		Summer		Autumn		Winter		Annual	
	Parameter	T °C	Q mm	T °C	Q mm	T °C	Q mm	T °C	Q mm	T °C	Q mm
Western Georgia	Baseline period	7.9	281	18.5	348	9.7	391	-2.3	377	9.1	1197
	Anticipated change Δ	4.6	-40	5.6	-88	3.4	-52.7	3.6	104	3.5	-70.0
	2100	12.4	241	24.1	260	13.0	338	1.4	481	12.6	1127
Eastern Georgia	Baseline period	9.3	158	20.5	170	11.6	126	1.0	85	11.3	570
	Anticipated change Δ	4.6	-65	5.9	-72	4.1	-45	4.5	-289	4.1	-83
	2100	13.9	93	26.4	98	15.7	81	5.5	56	15.4	487

Figure 14: Estimated temperature and precipitation changes through 2100 for Western and Eastern Georgia
Source: UNFCCC Second National Communication

Climate Change Vulnerability Index

Georgia is relatively vulnerable to climate change. Environmental protection, in general, is not a priority in the country which makes integrating climate change and sectoral development programs difficult. There are not sufficient national experts on climate change; a lack of relevant scientific assessments and surveys; insufficient coordination and information-sharing between relevant projects and programs being implemented in the country; and low awareness in the private sector, among decision makers, and among the general public.[4] Because information and awareness is so limited, it is difficult to adopt adaptation measures.

A recent World Bank report "Adapting to Climate Change in Europe and Central Asia" developed a series of indices to assess the exposure, sensitivity and adaptive capacity of countries to climate change in the ECA Region. The indices are based on a range of relevant parameters. For example, the exposure index was based on an extreme event dataset that combines the average additional number of 1:20 year events for hot, dry and wet years; hot, dry and wet summers; and hot, dry and wet winters projected over the 2070-2099 period relative to the 1961-1990 period. The vulnerability index displayed in Figure 15 is a combination of the exposure, sensitivity and adaptive capacity indices. The vulnerability of Georgia to climate change based on this index is high compared to other countries in the region. The main underlying drivers of vulnerability identified were the limited adaptive capacity and particular social and productive structures, which enhance the sensitivity of Georgia to climate change.[17]

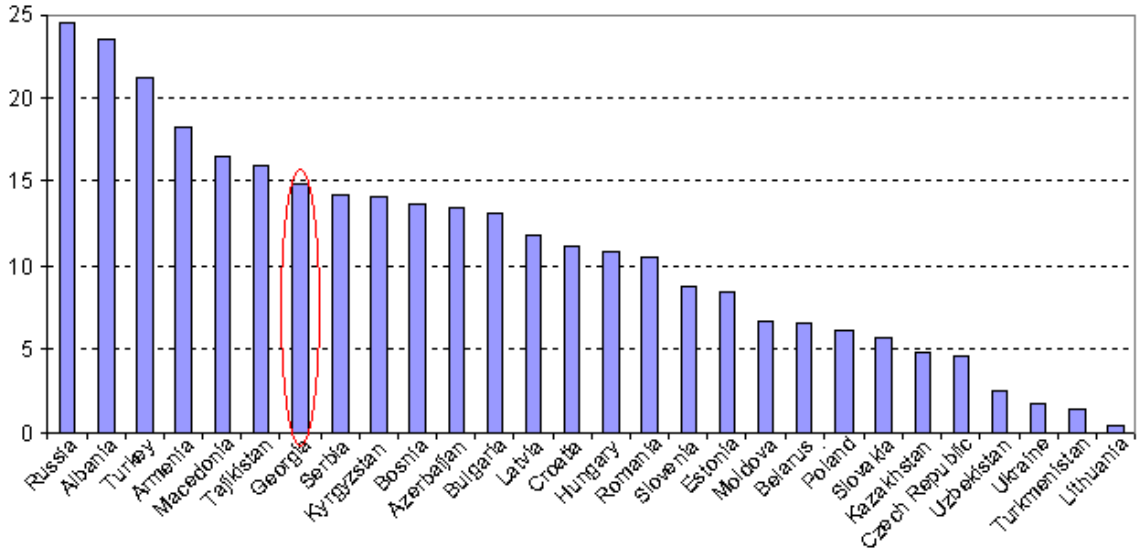


Figure 15: Climate Change Vulnerability Index, ECA Region
Source: The World Bank, 2009. Adapting to Climate Change in Europe and Central Asia, Washington DC

VII. *Impacts of Climate Change on Agriculture and Water Resources*

Agricultural Risks and Opportunities

A change in climate leads to potentially difficult conditions for crop production, including greater weather variability, but can also enhance production. In the Kobuleti region, climate change will result in better conditions for oranges and lemons. This could double income from the citrus sector. Projected decreases in precipitation may require modern irrigation systems from April to May and potentially during summer months as well.[4] Degradation of agricultural land and alpine pastures is expected due to decreasing rainfall and increasing temperatures. Water runoff is expected to increase by 4 to 7%, which could allow the production of 340 million kWh of additional hydro power in Western Georgia while also providing opportunities for irrigation reservoirs. Tea and maize production could increase due to better climate conditions in Western Georgia, with maize potentially increasing up to 30 to 40%. Decreasing rainfall and increasing temperatures in Eastern Georgia are expected to cause 10 to 15% declines in wine production and 30 to 60% declines in cereal production.[7] To date, however, only limited yield and water resource modeling has been done in the region, and variation in the effects of climate change on crops from the eastern to western parts of the country indicates that effects should be analyzed by agricultural zones, as previously described.

In the Kvemo Svaneti region in northern Georgia, weather events that have become more common with climate change including floods, landslides and mud torrents have resulted in increased erosion which, in turn, decreases agricultural output. Agriculture in the Dedoplistskaro region also faces decreases in yields resulting from droughts and high winds.[4] Predicted decreases in streamflow and precipitation, and increases in rates of evapotranspiration are expected to impact water resources in Georgia. Streamflow, in particular, is expected to decline by 26 to 35% and 45 to 65% in the Alazani (Ganikh) and Khrami-Debed basins, respectively, by 2100.[6] In the Dedoplistskaro region of Georgia, irrigation requirements for winter wheat, pasture, and sunflower are predicted to increase by 114%, 82%, and 50%, respectively, by 2100 compared to 1991 to 2005.[6] Although declines in pasture productivity (noted above) could affect the livestock sector, representing a negative indirect effect, no analyses to date have examined the possible direct effects of changes in temperatures and precipitation on livestock productivity in Georgia.

VIII. *Potential Adaptation Measures for the Agricultural Sector – Adaptive Capacity*

Georgia's First and Second Communication, as well as other documents, propose a range of adaptation options for key sectors, including agriculture, forestry, and water resources. A number of the adaptation options discussed are ready for implementation and are also technologies proven to increase productivity presently – a "win-win" situation. Unfortunately, many of these options have not been implemented because of constraints associated with a variety of economic and social factors.

With low levels of productivity, a highly variable climate and a high reliance on rain fed agriculture, Georgia has a significant food security risk. With growing global demand and increased agricultural vulnerability under climate change, this food security risk could increase substantially for Georgia. Poor rural communities are particularly exposed, as they have limited purchasing power in global food markets. Consequently, if adaptation options are implemented, the risks associated with the current climate, projected climate change and food security can be minimized.

Agriculture in certain parts of the country are particularly vulnerable to climate change, such as the eastern region which is predicted to suffer from decreased rainfall, and therefore decreased agricultural production in the future. Therefore, the focus for interested stakeholders should be on reducing the adaptation deficit by increasing efficiency, productivity, and adaptive capacity of agriculture to the present climate, while developing effective long-term adaptation options for a range of farming and livestock systems across the three agricultural zones of Georgia, with particular emphasis on the East. Given the uncertainties of climatic developments, these adaptation options need to be evaluated robustly under a range of different future climate scenarios. With limited finances, it is imperative that adaptation options that give the greatest return on investment from an economic, social, and environmental perspective be prioritized, Finally, it is essential that adaptation options are developed not only at the national scale, but at the agricultural zone scale, so that sub-national and local communities have adaptation options that specifically address the climate change challenges that they face. This will ensure that human and economic capital is directed towards the development and implementation of adaptation strategies that are relevant, targeted, and effective.

Rural communities have constantly adapted to changes in weather and seasons throughout history; however, the projections under climate change are highly likely to exceed even the most innovative farmers' ability to autonomously adapt. Although there are many field-ready innovations that could rapidly improve the resilience of agricultural systems in Georgia immediately, the lack of financial resources at the farm level is a considerable barrier to adoption. Additionally, significant investments will be required by the state and development partners to build the infrastructure, knowledge, and policy systems that will support and develop an array of adaptation options to increase the resilience of the farm sector in the future.

Specifically in terms of climate and water resources, some suggestions have been made for adaptation options. For climate, these include: increased investment in weather and climate services; data exchange among countries in the region on climate-related data, river discharge, lake levels, and more; and technical workshops to share regional expertise in forecasting. For water resources, UNDP recommends adaptation measures that may reduce the joint effects of land degradation and climate change. Recommendations include: (1) improve and rehabilitate irrigation systems to increase capacity and efficiency; (2) plant windbreaks to decrease erosion; (3) increase productivity through weed control, minimum tillage, contour plowing, and seeding of degraded areas; (4) improve soil fertility by using gypsum in alkali soils and chemical fertilizers in saline soils; and (5) increase water storage from May through October. Additionally, UNDP notes that in order to reduce wastage, incentives such as water pricing or enforcement of water quantity limits are necessary. The action to address water issues, however, is cooperation among the three countries. While development assistance for agriculture is generally declining, the rate of return to investment in research and extension for agriculture are high.[6]

The Ministry of Environment Protection and Natural Resources of Georgia and UNDP Country Office recommend some adaptation measures. In the short term, their recommendations include: (1) create a permanent monitoring and early warning system for sea level rise and storm intensity; (2) establish infrastructure to provide information about the effects of climate change and their economic implications; (3) establish a permanent committee responsible for planning and implementing adaptation measures; (4) provide a sustainable source of renewable energy resources and support private sector involvement; (5) implement coastal zone protection measures; (6) conduct sea shore protection measures in the Batumi-Adlia area; (7) establish plantation forests where degraded land cannot be restored; (8) provide farmers with modern technology for land cultivation and management; and (9) mobilize farmers through pilot projects. In the long run, the authors of the Second National Communication suggest rehabilitating eroded and salinized soils; restoring central wind-breaks; and restoring irrigation systems, where cost-effective.

IX. *Impacts of Agriculture on Greenhouse Gas Emissions*

In 2006, total greenhouse gas emissions amounted to 2,430 gigagrams CO_2 equivalent (Gg CO_2-eq) N_2O), 4,599 Gg CO_2-eq CH_4, and 5,873 Gg CO_2. CO_2 and N_2O emissions fell from 1990 to 2000, then rose from 2000 to 2006, and CH_4 emissions have slowly declined since 1990. The rapid decline in CO_2 emissions is mainly due to the fall of the energy and industry sectors since 1990. The decrease in CH_4 emissions since 2000 is primarily due to the reduction in leaks from natural gas transmission and distribution systems from improved maintenance of gas pipelines.[4]

In 2000, emissions from the agriculture sector made up 2,796 Gg CO_2-eq, comprising 25.5% of the total national GHG emissions[2,4], compared to agriculture's contribution to Europe's emissions as a whole of 8.9%.[18] Figure 16 highlights the proportions of greenhouse gas emissions by sector, and the sources of emissions within the agricultural sector. Emissions from the agricultural sector mainly include CH_4, N_2O, and CO_2, and have the following effects on national emissions:

- **CH_4 from agriculture**: Accounts for 28.8% of national CH_4 emissions and 14.1% of total greenhouse gas emissions, from enteric fermentation, and manure management.
- **N_2O from agriculture**: Accounts for 66.7% of total N_2O emissions and 11.4% of national greenhouse gas emissions due to emissions from agricultural soil, manure management, and field burning of agricultural residues.
- **CO_2 from agriculture**: Emissions are nearly negligible, as CO_2 produced due to energy consumption is included in emissions in the energy sector. In total, agriculture, fisheries and forestry comprise 5.3% of CO_2 emissions from the energy sector, 4.6% of total CO_2 emissions, and 1.5% of national greenhouse gas emissions.

Agricultural emissions including CH_4 from enteric fermentation, N_2O from animal production, and CH_4 from manure management remained relatively constant from 2000 to 2006, while N_2O from synthetic nitrogen fertilizers increased by nearly 81% and N_2O from crop residue decomposition decreased by about 44%.[4]

Carbon Trading and Agriculture

The Clean Development Mechanism (CDM) allows developed (Annex I) countries to implement mitigation projects in developing (non-Annex I) countries in order to instigate investment and promote transfer of environmentally friendly technologies. In Georgia, legal and operational components for CDM projects are established and priorities for the country have been identified. In 2002, the Ministry of Environment Protection and Natural Resources was named the Designated National Authority. However, weak market infrastructure, inaccessibility of data to understand baseline scenarios, and little potential of CDM projects create barriers to implementation. Re-training local experts and encouraging young experts to be involved in international programs, and improving availability of national statistics could help improve the potential of CDM projects.[4]

The main CDM program priorities in Georgia are natural gas transportation, chemical industry, cement production, transport, heat and hot water system, use of renewables, and landfill/waste management – agriculture is not represented.[15]

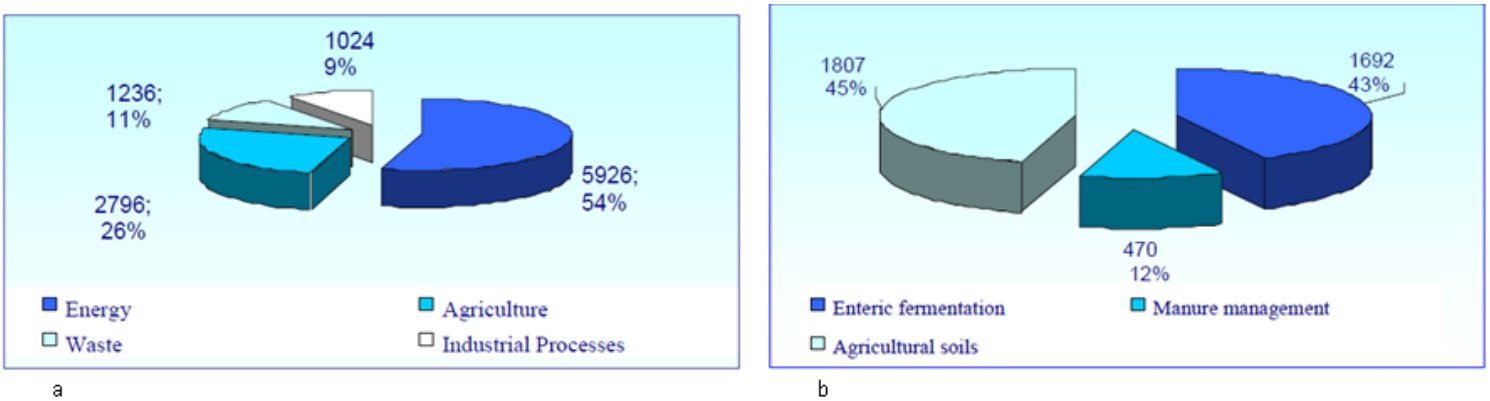


Figure 16: (a) Sectoral GHG emissions (Gg CO_2-eq) and share in national emissions in 2000 and (b) GHG emissions from the agricultural subsectors and their share in sectoral emissions in 2000
Source: UNFCCC Second National Communication

Mitigation Potential in Agriculture

Various mitigation techniques exist to mitigate emissions in the agricultural sector of Georgia. These can include policy, legislative, capacity building, financial, technical, research and development, education and public awareness measures. Some examples of mitigation measures in the agricultural sector, and their relative cost-effectiveness, are shown in Figure 17. While restoring cultivated organic soils has the largest mitigation potential overall (dark green bar), there are many options related to cropland management that are less expensive (light green bar).[5] More specific examples of mitigation measures include the following[5]:

- Crop Production Management
    - Improve crop varieties, extend crop rotation, avoid or reduce use of bare fallow
    - Adopt integrated nutrients management in order to reduce emissions in production
    - Plant annual vegetation between tree or vine crops to capture carbon
    - Improve nitrogen use efficiency to reduce N_2O emissions from fertilizer use and greenhouse gas emissions from production
    - Reduced- or no-till agriculture can reduce CO_2 emissions from the soil, can eliminate pre-harvest burning
    - Increase irrigation efficiency to enhance carbon storage
    - Revert cropland to other types of land cover similar to native vegetation to increase carbon storage

- Grazing Land and Livestock Management
    - Optimally graze lands to capture carbon
    - Reduce biomass burning and change timing to decrease CH_4, N_2O, tropospheric ozone, smoke aerosols, and changes in the albedo of land surface
    - Introduce grass species with higher productivity or carbon allocation to deeper roots
    - Feed livestock more concentrates, and use specific agents and dietary additives to reduce methane emissions in livestock
    - Change animal breeds to varieties that produce less methane output per unit of animal product
    - Institute manure management to reduce N2O and CH4 emissions. These can include digestion, covering manures, altering feeding practices, and composting

Investments in these mitigation techniques have the potential to result in reduced greenhouse gas emissions, improved climate resilience, and increased productivity, making them priority options.

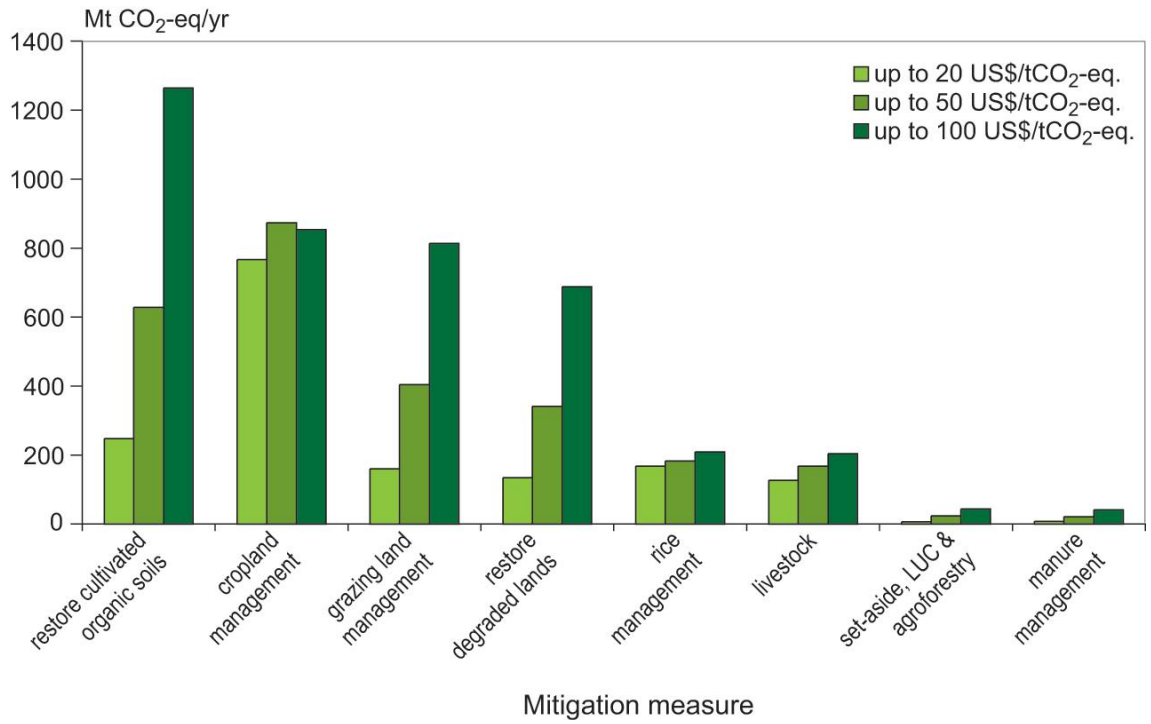


Figure 17: Smith, P. et al. 2007: Agriculture. In Climate Change 2007. Mitigation. Contribution of Working Group III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change [B. Metz, O.R. Davidson, P.R. Bosch, R. Dave, L.A. Meyer (eds)], Cambridge University Press, Cambridge, United Kingdom and New York, NY, USA.

Some agricultural emissions mitigation projects have already begun in Georgia. The World Bank's Agricultural Research, Extension, and Training Project, now complete, disseminated agricultural knowledge to increase sustainable agricultural production and reduce pollution of natural resources. Specifically, the project mitigated climate change through the adoption of 200 bio-gas digesters that reduced methane emissions and timber use.[19]

Additionally, an afforestation project with hazelnut plantations in western Georgia is underway through Agrigeorgia, LLC, Georgia and GET-Carbon USA, working with communities in the Samegrelo Region of Georgia. The project aims to reclaim abandoned lands in the sustainable production of food that can be sold locally and internationally, to increase employment and technology transfer to local communities, and to use carbon finance to increase economic returns and reduce risk. The project is scheduled to last from 2007 through 2057, involve 250 households, and could have a benefit of 300,000 tonnes of carbon dioxide mitigation.[20]

X. *The Policy Context*

The First and Second National Communications of Georgia on climate change are the primary policy documents that assess the impact and outline adaptation options to respond to the projected future climate hazard. The First National Communication includes the 1987 to 1997 greenhouse gas inventory, 1980 to 1997 greenhouse gas emissions trends, mitigation measures, projection of emissions until 2010, assessment of Georgia's vulnerability to climate change, and the general characteristics of adaptation measures. The Second National Communication expands upon studies and assessments related to climate change from the First National Communication, including improvements and updates to the greenhouse gas inventory and emission trends, mitigation strategies, development of climate change scenarios, evaluation of vulnerabilities and priority adaptation areas, monitoring systems, and public awareness of climate change. The Second National Communication therefore provides an excellent launching point for further work on adaptation in the agricultural sector.[4]

National Plans, Strategies, Programs, and Analytical Studies

State policy is meant to protect and rationally manage the environment and natural resources, and specifically to support income generation and food security. Methods of accomplishing these goals include: (1) implementing sustainable agricultural development, (2) supporting environmentally friendly farming practices; (3) monitoring and assessing soil fertility, and (4) registering pesticides, agrichemicals, and new varieties of plants and livestock. However, the agriculture sector plan for 2006 through 2009 does not address environmental protection in the agricultural sector, nor address environmental problems such as salinization, soil erosion, overgrazing, deforestation, and wetland drainage. Additionally, other than donor projects, there is no extension system for farmers and foresters.[12]

Although Georgia does not yet have a comprehensive national agricultural policy in place, a draft National Food and Agriculture Strategy (2006-2015) was created and submitted to the Ministry of Agriculture (MOA) for consideration under the USAID-funded technical assistance project AgVantage. One chapter is directed at environmental protection and sustainability, addressing issues such as soil erosion, water pollution, and handling of pesticides and agrochemicals, and reporting *ad hoc* policy measures and cost projections for 2007 through 2008.[12]

Georgia also has a variety of laws protecting the local environment. Georgia has passed the Law of Soil Protection in 1994, the Law on Amelioration of Soils in 1997, and the Law on Soil Conservation and Reclamation in 2003, and Georgia ratified the UN Convention to Combat Desertification in 1999. In February of 2007, the MOA and Ministry of Environment (MOE) produced and submitted a Code of Good Agricultural Practices. The code includes legislation, recommendations, and advice for those employed in the agricultural sector to reduce environmental impacts of farming, to limit use of natural resources, water, soil, and air, and to advance the use of environmentally friendly farming practices.[21] Georgia voluntarily endeavors to implement the Code of Good Agriculture Practice (CGAP), as exists in the EU and other developed countries. CGAP provides advice on eliminating or decreasing pollution across all major sectors of agricultural activity. The Georgian CGAP is a statement of goodwill by the nation to continue to develop its agricultural sector without causing environmental damage on local and global scales.[22]

In general, a key issue in this context is that laws and policies are well-thought out and thorough, but enforcement and implementation can be inadequate, owing to limitations in resources, capacity, outreach, and/or relevant knowledge.

Law or Policy	Year adopted
Law on Soil Protection	1994
Plant Protection Law and related legislations to regulate pesticides and chemicals	1994-1998
Law on Pesticides and Agrochemicals	1998, 2005
Water Law, which manages water resource management	1997
Law on Amelioration, which defines and regulates water resource use and disposal through improved irrigation and drainage	1997
Law on Soil Conservation and Reclamation	2003
Ratified the UN Convention to Combat Desertification	1999
Individual nutrient (nitrogen and phosphorous) management plans were developed for 220 farms in the Black Sea region	2002-2004
A public education campaign was launched to address soil erosion causes and prevention, and guidelines were published	2005-2006
Code of Good Agricultural Practices submitted to reduce negative effects of farming on the environment, rationalize use of natural resources, water, soil, and air, and promote environmentally friendly practices	2007
Law on Organic Production	2008
National Food and Agriculture Strategy (draft)	2006-2015

International Efforts

Numerous programs, many financed by external sources, have aimed to lessen agriculture's impact on the environment. For example, from 2002 through 2005, environmentally friendly farming practices such as erosion control methods were introduced to 129 villages on the Black Sea coast, covering a total of 571 ha. Improved methods included terracing, contour plowing, and buffer strips, and farmers learned about crop rotation, new crop varieties, and soil amelioration. Others addressed environmental concerns such as reducing pollution from manure through proper collection, storage and disposal techniques.[12] The CGAP, published in 2007, brings Georgian agriculture closer to the environmentally friendly agricultural practices introduced in the EU and in other developed countries. Other international efforts in the agricultural sector are listed below:

Organizations	Programs
Ministry of Environment Protection and Natural Resources of Georgia and UNDP	Preparation of Initial (1999) and Second (2009) Communications.[2,4]
Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES), partially through FAO	Projects to address the Highly Pathogenic Avian Influenza (HPAI) crisis in Asia, and to provide vaccines against three types of Foot-and-Mouth Disease.[23]
Food and Agriculture Organization (FAO)	*Emergency and Rehabilitation Coordination Unit* (ERCU) to provide technical assistance and ensure distribution of essential inputs to the most vulnerable communities. In Georgia this includes a supply of livestock-feed and assistance in planting spring food crops in conflict-affected areas.[24]
U.S Department of Agriculture (USDA)	*The Caucasus Agribusiness Development Initiative in Armenia and Georgia* helps farmers and agribusinesses grow, raise incomes, and create jobs in order to create sustainable livelihoods in rural areas.[25]
USAID	*Economic Prosperity Initiative, 2010-2014*, will improve the nation's economic competitiveness through improving the economic governance capacity, increasing agriculture sector productivity, and enhancing non-agricultural value chains with high growth potential.[26]
USAID and Chemonics	*New Economic Opportunities (NEO), 2011-2015*, aims to increase rural incomes, reduce poverty, improve food security, direct efforts towards infrastructure priorities, allow sustainably maintained households, and help distressed communities.[26]
USAID and CNFA	*Agricultural Mechanization Project, 2009-2012,* will create institutions and systems for a private-sector focused, sustainable small holder approach to provide mechanized agricultural services that will increase productivity, competitiveness and profitability in the agricultural sector.[26]
USAID	Current Farmer-to-Farmer (FTF) Program, 2009-2013, helps to develop and increase sustainability of private agricultural enterprises, support organizations, and rural finance organizations.[27]
USAID and Bank Republic	*Loan Portfolio Guarantee for Bank Republic, 2005-2015*, extends a Development Credit Authority (DCA) loan portfolio guarantee to lend to Bank Republic in order to allow commercial credit to agricultural and non-agricultural sectors, or any activity that will improve technology or increase employment.[28]
USAID and Basis Bank	*Loan Portfolio Guarantee for Basis Bank, 2010-2018*, extends a DCA loan portfolio gua Basis Bank to allow commercial credits for small and medium-sized enterprises, includi agribusinesses.[29]
European Investment Bank (EIB)	EIB, the World Bank, and the European Bank for Reconstruction and Development committed to providing financial resources to central and eastern Europe in 2009. They create a facility allowing investments in energy and environmental projects.
World Bank	*The Irrigation and Drainage Revitalization Program:* This projects aim to revitalize the irrigation and drainage sub-sectors and to develop an institutional foundation for the sub-sectors' long term sustainability. [29]
World Bank, International Bank for Reconstruction and Development	*The Agricultural Research, Extension, and Training* (ARET) Project, 2002-2005, to increase production sustainably while decreasing pollution of natural resources. This includes improving on-farm environmental practices and reducing greenhouse gas emissions.[14]
World Bank, International Development Agency, and IFAD	*Agricultural Development Project (ADP)* became effective in 1997 and aimed to form village-based rural financial intermediaries and form an active land market.[17]
REC Caucasus	Support Development of Biodiversity Conservation Policies and Practices in Mountain Regions of the South Caucasus, 2011-2014.[30]

XI. *The Institutional Context*

The Ministry of Agriculture (MOA) and the Ministry of Environment (MOE) are responsible for agriculture and environment, respectively. The two ministries coordinate on registration of pesticides, residues, and waste, and the handling and inventory of obsolete pesticides. Both Ministries are responsible for environmental policies and monitor the illegal importation of pesticides. Financial support of environmental issues such as soil fertility and erosion has decreased in the MOA's annual budget from 2004 through 2007.[1,12]

Institutional structures in Georgia which are directly related to climate change are responsible for coordinating, directing, and monitoring policies and measures; preparing legislative basis and proposals and their submissions to Committees of the Parliament; monitoring planned measures; and monitoring documentation to be submitted to UNFCCC. These institutions include:

- Climate Change Administration at the Ministry of Environment Protection and Natural Resources,
- National Environmental Agency at the Ministry of Environment Protection and Natural Resources, and
- Department of Forestry at the Ministry of Environment Protection and Natural Resources.

Other important governmental structures are responsible for exchanging data and proposals, considering climate change in sectoral development plans, and raising awareness. These structures include:

- Ministry of Economic Development and in particular its Department of Statistics and Department of Transport,
- Ministry of Energy,
- Ministry of Agriculture,
- Ministry of Health Care,
- Ministry of Finance,
- Ministry of Foreign Affairs,
- Ministry of Culture, Protection of Cultural Monuments and Sports and its Department of Tourism, and
- Ministry of Education and Science.

Committees of parliament in Georgia are responsible for supporting the legal basis for the implementation of the UNFCCC and CDM of the Kyoto Protocol, and incorporating climate change concerns in sectoral and regional development plans. Committees of parliament of note are: Environment Protection and Natural Resources; Economic branches and economic policy; Agriculture; Education, science and culture; Health care and Social Services; and Regional policy, local municipal and highlands administration.

An important scientific organization for data exchange, processing, and scientific research and analysis is the National Academy of Sciences of Georgia. This comprises the Scientific Research Institute of Hydrometeorology; Institute of Geography, Institute of Geophysics, Institute of Botany; and I. Javakhishvili Tblisi State University. Local, municipal, and regional structures are also important to note for exchange of data and proposals, cooperation in project implementation, and raising awareness. Private sector and industrial enterprise; research, extension and educational institutions, non-governmental organizations, mass media, and national experts can also help.[4]

XII. *Ways Forward*

In April of 2012 an Awareness Raising and Consultation workshop on Reducing Vulnerability to Climate Change in Georgian Agricultural Systems was held in Tbilisi, Georgia. During this event, a draft version of this Climate Change and Agriculture Country Note was disseminated to agricultural sector stakeholders and helped generate a groundswell of support and interest for further analytical work to reduce the vulnerability of the agricultural sector to climate change.

The next step is for Georgia to work jointly with the World Bank to develop the Georgian Response to Climate Change for Agriculture program. Broadly, this work involves rigorous analysis and economic modeling to assess both the impacts of climate change and potential adaptation and mitigation measures for a range of farming, livestock, and production systems at both national and sub national levels. More specifically, the analysis involves collecting current local data on climate, water resources, soils, and agricultural practices; developing climate scenarios; modeling crop yields and water resource supply and demand; and assessing the costs and benefits of specific adaptation and mitigation measures. The result is a prioritized list of actions to improve the climate resiliency, greenhouse gas efficiency, and yield productivity of the agricultural sector, results which can then be reviewed with farmers and local experts to gather their insights. This

analysis will be performed by expert staff from the international consulting firm Industrial Economics, Inc. (IEc), in close consultation with local experts across a range of organizations, under the direction of the World Bank. IEc will also deliver training and capacity building services to local experts and has organized sub-national consultation meetings with farmers, policymakers, and researchers to raise awareness of the risks and opportunities posed by climate change on the agricultural sector.

This work will culminate in the development of an Agriculture and Climate Change Impact Assessment & Menu of Adaptation Options that will highlight the physical, economic, and social impacts of climate change on the agricultural sector and identify adaptation and mitigation priorities for investments, capacity development, and policy improvement. These options will be practical and operational, with a focus on "win-win-win" options that have benefits for adaptation, mitigation, and the local economy. This analysis will be discussed at a high-level National Dissemination and Consensus Building Conference to be jointly hosted by the Ministry of Agriculture and the World Bank in the fall of 2012. The conference will help build consensus on the way forward by identifying practical priorities for action.

A Regional Knowledge Exchange Conference will follow, wherein Georgian experts can share their experiences and results while simultaneously learning from experts from other countries in the Southern Caucasus. The main objective of this conference will be to assist Georgian experts in developing an Agricultural Sector Climate Adaptation and Mitigation Action Plan. In addition, World Bank staff will help identify possible financing sources for the highest priority actions. This forum will also explore opportunities for greater regional collaboration and assist with the establishment of communities of practice for experts working on agriculture and climate change issues. Finally, the World Bank team will prepare a regional synthesis report that can serve as a guide to further work.

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