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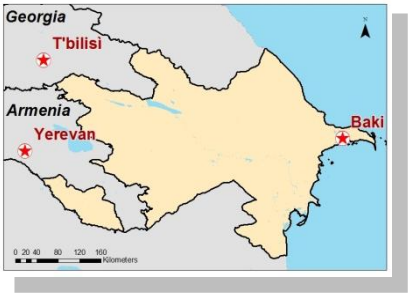
The Republic of Azerbaijan

CLIMATE CHANGE AND AGRICULTURE COUNTRY NOTE

June 2012



www.worldbank.org/eca/climateandagriculture

This Country Note for Azerbaijan 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 and mitigation 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 Azerbaijan 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 Baku in March 2012. Feedback and comments on the Note from this consultation process have been incorporated into this updated version in collaboration with the Azerbaijan Ministry of Agriculture.

Climate Change Exposure and Risk for Azerbaijan

Azerbaijan is especially vulnerable to climate change, with 39.7% employment in agriculture[34], 47% of the population lives in rural areas,[34] and 7.6% of the nation living under the national poverty line as of 2011.[31] Agriculture is a highly climate sensitive sector, and therefore, Azerbaijan's rural population and their livelihoods are vulnerable to climate change. Azerbaijan is in the northern end of the subtropical zone, leading to mild winters and moisture shortage in the summer, with constant droughts. A large range of climates can be found in Azerbaijan, with semi-desert and dry lowlands and foothills to mountain tundra and high mountain regions.[3] Future climate projections indicate that Azerbaijan will be exposed to:

- Mean temperature increases of 0.30°C per decade from 2021 to 2050,[3] with a cumulative change of from 1.4°C to 2.8°C in 2050;[35]
- Future annual precipitation may increase by 10 to 20% by 2050 compared to the 1961 to 1990 baseline period,[3] though with decreases in rainfall during the growing season – forecasts can vary substantially by month and by climate model;[35]
- Reductions in streamflow of 26 to 35% in the Alazani (Ganikh) Basin, and reductions in streamflow of 11 to 14% in the Agstafa Basin by 2100;[5]
- A more risky agricultural production environment, as increases in temperatures and reduced precipitation during critical crop and pasture growth periods will cause a large soil 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 – such as increased areas suitable for pasture. Both risks and opportunities need to be carefully assessed.

In this Note

Azerbaijan at a Glance

(World Development Indicators 2012 and State Statistical Committee 2011)

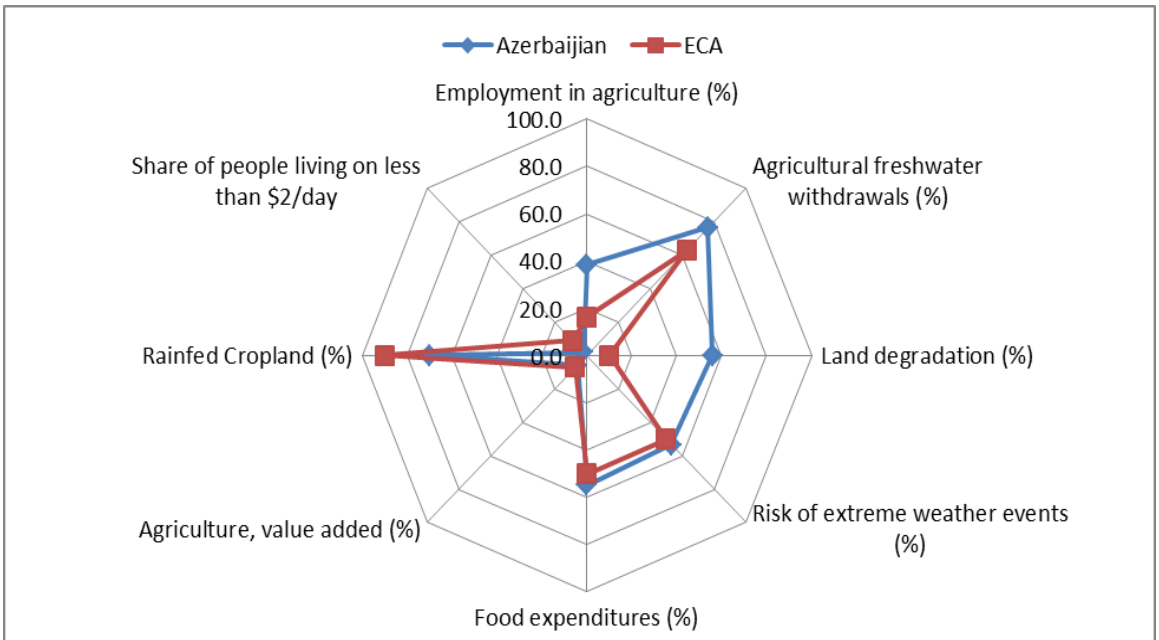
Population	9.11 million
Population below the poverty line	7.6%
GDP	52.1 billion USD
GDP Per Capita	5,713 USD
Agriculture as a % of GDP	5.4%

I. *Introduction*

Climate change is an essential issue for Azerbaijan due to the exacerbation of droughts, water scarcity, and soil degradation in the Southern Caucasus region. The region is already experiencing the effects of the changing climate on nature and on its people. The southern Caucasus continues to experience insufficient access to safe drinking water and water shortage which is particularly problematic in Azerbaijan. Currently, the region experiences non-sustainable use of natural resources, significant land degradation (from overgrazing, soil pollution, and erosion), deforestation, and lacks access to safe drinking water in some areas. The expected changes in climate, such as increasing temperature, decreasing water availability, and increasing frequency and magnitude of extreme events, will intensify these issues and impede development in the region. Integrating climate change into development goals will help reduce some of these impacts.[6] Some work has been done to address climate change in Azerbaijan and in the Southern Caucasus region. Azerbaijan, as a transition country (Non-Annex 1), has submitted two National Communications to the United Nations Framework Convention on Climate Change, and some agricultural policies address adaptation and mitigation priorities in the agricultural sector.

Agriculture is of great importance to Azerbaijan, accounting for a large portion of employment, rural livelihoods, food security, and rural growth. However, the sector is highly climate sensitive and there exist potential adverse changes in temperature, precipitation, and frequency of extreme events (e.g. droughts, heat waves, floods) with climate change. As a result of climate change, existing inequalities between rich and poor populations and vulnerable communities within Azerbaijan could be exacerbated and place a strain on institutions, food supply, and rural growth. Additionally, the country's limited institutional capacity to respond to natural climate hazards also poses a threat to future sustainable agricultural production and rural development.

Figure 1 displays eight climate change vulnerability indicators and compares Azerbaijan to the Europe and Central Asia (ECA) Region average for transition economies. Although Azerbaijan is near the ECA average for several indicators, the country has a significantly higher percentage of the population employed in the agricultural sector, a larger fraction of the population living in poverty, and a higher percent of land degradation. European countries have an average of just 4.5% of the population employed in agriculture,[2] as opposed to 39.7% in Azerbaijan,[34] and the average GDP derived from



Sources and Notes:
1. Employment in agriculture (% of total employment) based on World Development Indicators for 2007 (Azerbaijan) and 2008 (ECA).
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: Azerbaijan Vulnerability Indicators

agriculture for high income European countries is 2%, significantly lower than Azerbaijan at 5.4%. Additionally, 7.6% of the Azerbaijan population lives under the national poverty line.[31] These factors make the nation particularly vulnerable to climate change.

Geography

Azerbaijan is a small country, about 86,600 km^2 in area, located in the southern Caucasus.[3] The region is shown in Figure 2. Azerbaijan is located at 38°25' to 41°55' North Latitude and 44°50' to 50°51' East Longitude. Its neighbors are Russia, Georgia, Armenia, Turkey and Iran, and in the east, the Caspian Sea. Its border with Russia in the north stretches 289 km, Georgia borders 340 km of the northwest, Armenia borders 766 km of the west, Turkey borders 11 km of the southwest, and Iran borders 618 km of the south. The Eastern part of the country borders 825 km of the Caspian Sea. The Nakhchivan Autonomous Republic of Azerbaijan is an area of land in the southwestern portion of the country that is geographically separated from the rest of the country. This part of Azerbaijan is bordered by Iran to the southwest, Armenia to the northeast, and Turkey in the northwest.[3] Currently, there are one Autonomous Republic (Nakhchivan Autonomous Republic) and 90 administrative-territorial units (including 66 regions, 11 cities and 13 urban districts) in Azerbaijan. The average altitude is 384 meters with a range of -27 to 4,466 meters. Mountains dominate the northern, southern, and western regions of Azerbaijan, covering roughly 43% of the country, and flatlands run throughout the center of the country, accounting for the other 57% of Azerbaijan's land area.[6] Forests only make up roughly 11% of the total land area[2] but an estimated 21% of the country is arable[34], and about 50% is considered cultivable.[8] Vegetation conditions across the country can be seen in Figure 3. Azerbaijan has four major river basins, two of which are international. These include the Kura and Araks River Basin and Samur River Basin, which are both international basins, and the Caspian Sea coastal river basin in the northeast and the Caspian Sea coastal river basin in the Lankaran region in the southeast, which are both contained within the country.[8] Portions of Azerbaijan are seismically active and, in these locations, mud flows are common.[7] The region experiences non-sustainable use of natural resources, and land degradation (from overgrazing, soil pollution, and erosion). Additionally Azerbaijan suffers from deforestation and water shortages.[6]

Demography

Azerbaijan's population in 2011 was 9.1 million compared to 8.5 million in 2006. About 53% of the country's citizens reside in urban areas.[34] The country is densely populated with about 105 people per km^2,[2,34] with the highest densities occurring in the Absheron Peninsula and the lowest in the central highlands.[3] In 2009, life expectancy at birth was 70 years.[10] As of 2011, about 7.6% of the country was at the national poverty line,[31] down from almost 50% in 2001.[2] For the poorest 10% of the population, food comprises up to 65% of their total expenditures which, although quite high, is a significant improvement over the 80% recorded in 2001.[12] In Azerbaijan, the natural increase in population more than outweighs the migration loss, so population continues to grow.[13]

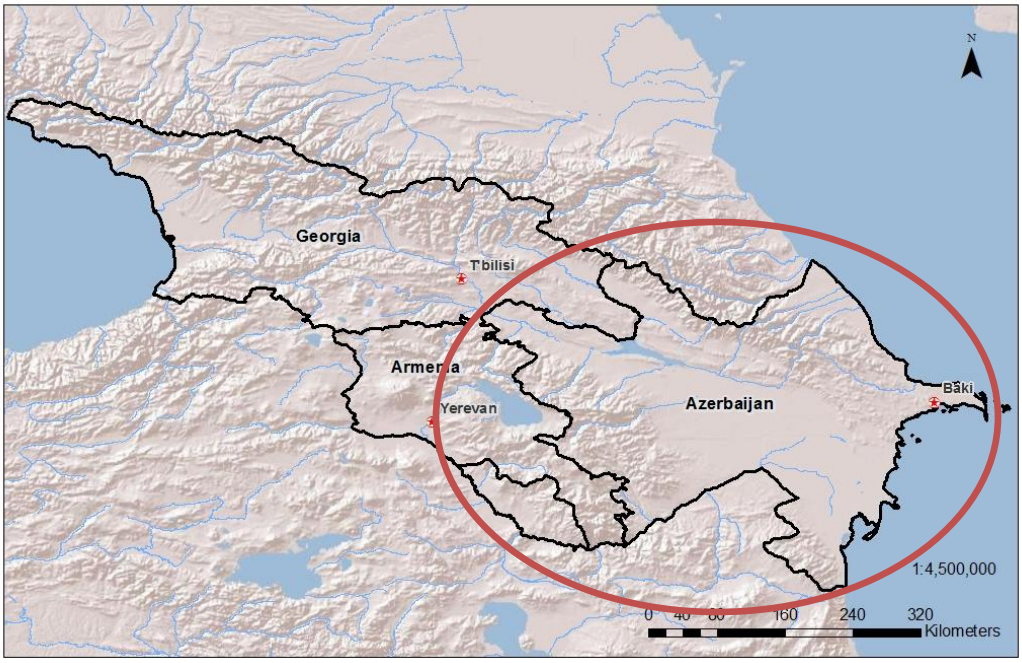


Figure 2: Relief Map the Southern Caucasus
Source: ESRI Online and IEc analysis

II. *Agriculture*

The agricultural sector is very important in Azerbaijan. In 2009, about 58% of the country's total land area was used for agricultural purposes (for annual crops, permanent crops, and permanent meadows and pastures); the breakdown of total land area is shown in Figure 4.[15] The most important crops in the country include cereals, cotton, potatoes, grapes, vegetables, fruits (including subtropical), melons, sugar beet, sunflower, tobacco and tea.[3, 8] Additionally, cucumbers, tomatoes, cabbage and eggplant, and various types of jams are canned.[14] In total, 90% of the volume of crops grown are cereals, the most common of which is wheat.[3] The agricultural outputs with the highest value of production in 2009 were cow milk, wheat, cattle meat, and tomatoes.[15] The areas planted with each crop are shown in Figure 5 and the production of each crop is shown in Figure 6. Overall, land area devoted to cereals, fruits (excluding melons), and vegetables (including melons) increased by 27%, 33%, and 7%, respectively from 2001 to 2010. Production of cereal was variable over the past decade, with an overall decrease of 1%; however, fruit production increased by 58%, and vegetable production increased by 35% from 2001 to 2010.[15]

Cattle breeding, poultry farming, forestry, and fishing are considered well developed aspects of the economy. Animal husbandry provides the population with meat, dairy, and poultry, and provides the industrial sector with wool, fur, rawhide, down, and other materials. Over half of total income from animal husbandry comes from cattle-breeding, which mainly occurs in the Kura-Araz Lowland and in foothill regions. Cows, sheep, and goats encompass the majority of animal husbandry, though buffalo breeding is also important in milk production, where buffalos account for over 20% of livestock in the country. Sheep breeding for meat and wool is most prominent in mountainous regions, and poultry farming is becoming increasingly profitable due to its production of meat, eggs, and down.[3] Figure 7 depicts the trends in livestock numbers over time; overall, livestock appears to be increasing. FAO data

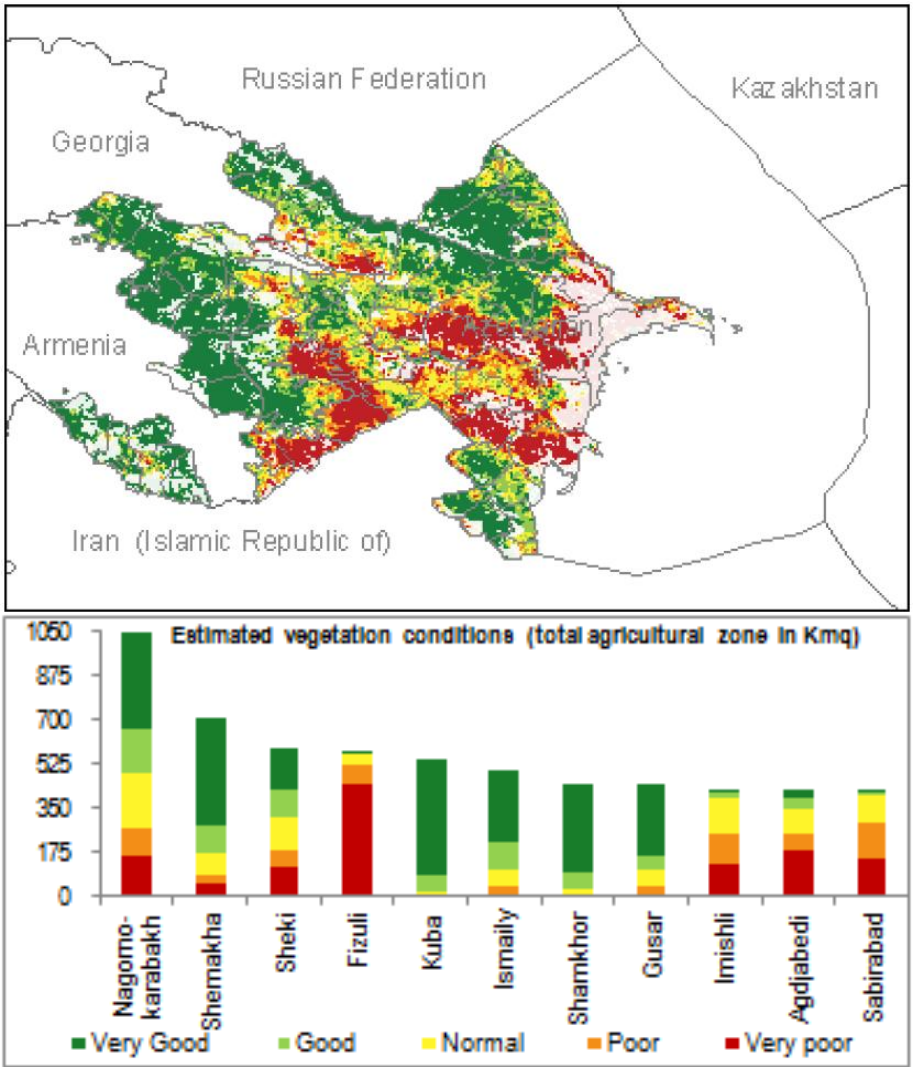


Figure 3: Estimated Vegetation conditions
Source: FAO Highlights

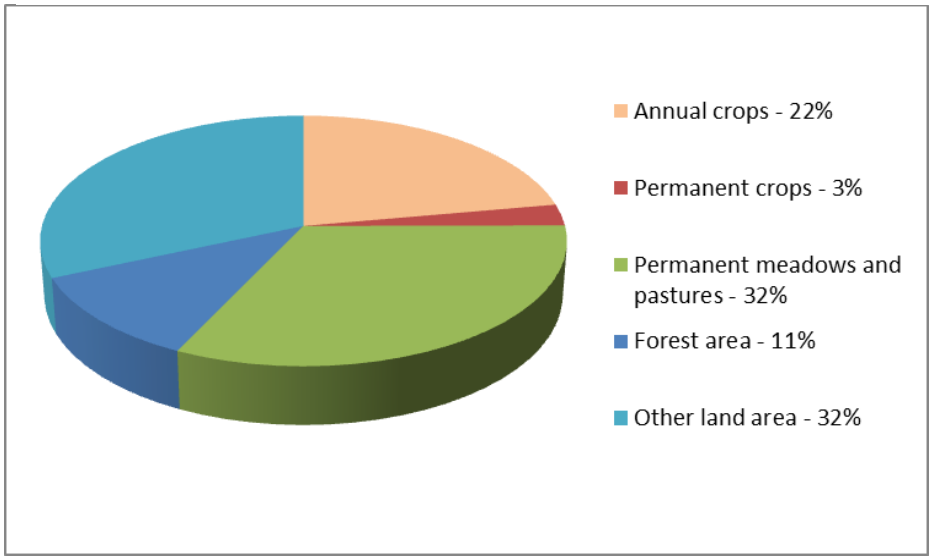


Figure 4: Land use in Azerbaijan,
Source: FAOSTAT. ResourceSTAT. http://faostat.fao.org/site/377/default.aspx#ancor

suggest poultry are a significant and growing component of the overall livestock outlook in Azerbaijan.

Agriculture still faces difficulties though; in many regions, precipitation is both inadequate and inconsistently distributed.[3] As a result, roughly 30% of agricultural land is irrigated,[34] and it is this land that accounts for more than 80% of Azerbaijan's total agricultural output.[3] In 2010, cereal production fell 33% from 2009 and was 14% below the average annual production between 2005 and 2009, with much of this drop attributed to flooding.[12]

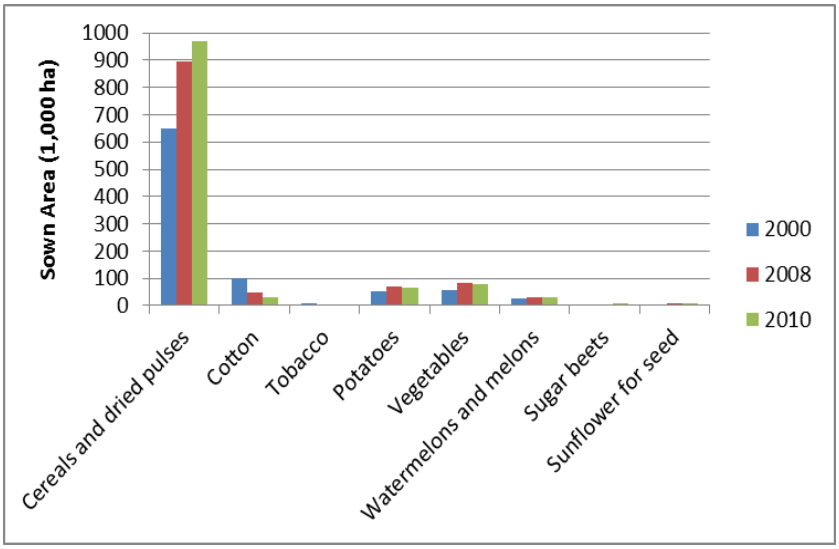


Figure 5: Area Planted by Crop in Azerbaijan
Source: AZStat.org 2012

III. *Agriculture and the Adaptation Deficit*

The sensitivity of the agriculture sector to the climate has important implications in Azerbaijan. Since 7.6% of the population lives under the poverty line,[31] 39.7% of employment is in the agricultural sector, and 47% of the population lives in rural areas,[34] rural communities are especially vulnerable to and at risk from climate change. This risk is further exacerbated by the relatively low productivity stemming from 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 8. For example, the average wheat yields in the period 2007 to 2009 for Azerbaijan are 37% of those in Western Europe.[15] This underperformance results from a complex set of factors, including distortions and imperfections in agricultural output and input markets; poor quality public services such as agricultural education, extension, research, and market information systems; undeveloped agricultural land markets; lack of access to finance; unsustainable management of soils; in sufficient irrigation; inability to irrigate due to polluted water; 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.

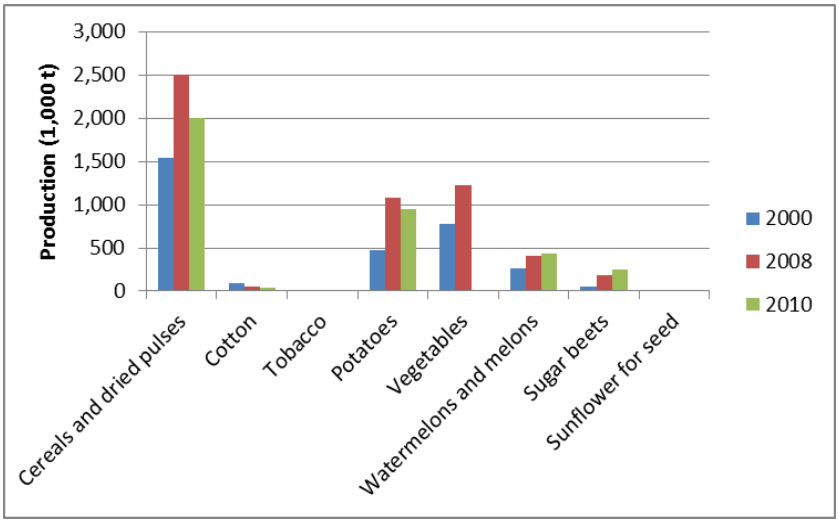


Figure 6: Crop Production in Azerbaijan
Source: AZStat.org 2012

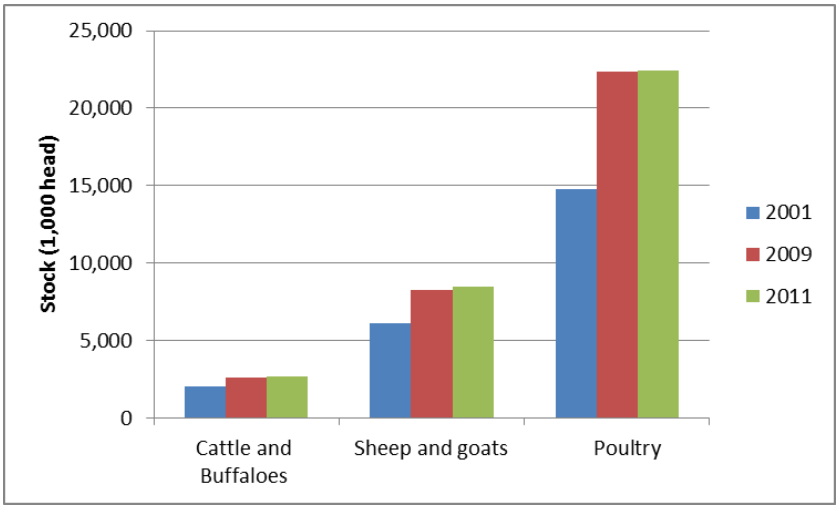


Figure 7: Number of livestock over time (thousands head)
Source: AZStat.org 2012

IV. *Agriculture and the Economy*

Azerbaijan began the process of land privatization, a important factor affecting the level of agricultural production in the overall economy, in the early 1990's. In general, privatized agricultural land fell into one of three categories: "*agricultural enterprises*, registered as legal entities, include agro-industrial enterprises, joint ventures, and agricultural cooperatives that employ people; *peasant farms*, a type of individual enterprise where the farmer is directly involved in production; or *household or private farms*, very small plots or gardens for personal or household use".[16] Privatization and a later land reform led to an increase in production. Farm output started to grow in 1998, with the highest growth, roughly 12 percent, in 2001. Small farmers contributed significantly to the economic recovery of the agricultural sector, but their small size and lack of mechanization are continuing issues in achieving high yields. [16]

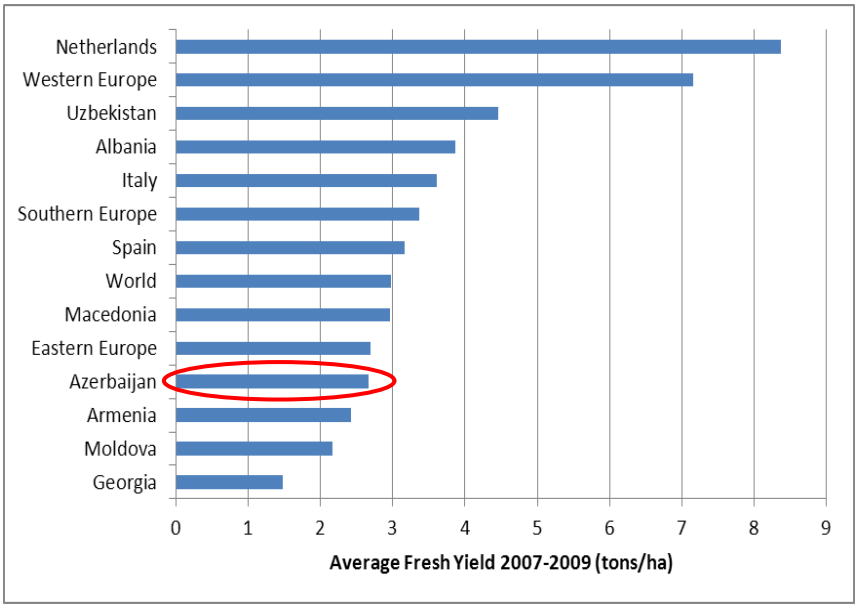


Figure 8: Average Wheat Yields in Select Countries, Averaged from 2007-2009
Data Source: FAOSTAT

Gross domestic product has increased substantially over the past decade, outstripping growth in the agriculture sector. In 2010, the per capita gross domestic product (GDP) was 5,713 USD, a large increase over the 2006 GDP per capita of 2,487 USD.[34] Despite the growth of the economy and the agricultural sector, agriculture's share in GDP has declined. In 1995, agriculture comprised 25.3% and fell to 5.4% of the 52.1 billion USD GDP by 2010.[34] This is largely due to rapid industrial development from 1995 to 2004.[8] Despite its declining role in the national economy, in 2010, about 39.7% of the labor force was employed in the agricultural sector.[34]

Recent increases in agricultural prices have been troubling for Azerbaijan because food is such a large portion of individuals' expenses. A fifth of the population spends over 60% of their budget on food.[12] Between August and December 2010, the price of wheat increased 82%.[12] Beef prices also increased, starting in July 2010, despite declines between 2008 and 2010.[12] These price increases were a result of a drop in supply. To combat rising prices, the government exempted wheat, meslin, and wheat and rye flour from VAT between December 2010 and August 2011.[12] As a result, Azerbaijan increased its importation of cereals by 45% relative to 2009, costing the country 270 million USD, a 44% increase in cost from the previous year.[12]

The European Union (EU) is attempting to forge a closer connection with Azerbaijan overall and within the agricultural sector, with the goal of gradual economic integration and more political co-operation. For example, in 1999 a Partnership and Cooperation Agreement between the EU and Azerbaijan was initiated, and in 2003, the European Neighbourhood Policy included Azerbaijan. Azerbaijan participated in the Eastern Partnership in May of 2009.[17] More recently, the European Commission has assisted in a wide range of projects in Azerbaijan, including those relating to food security and vocational training in agriculture.

V. *Agriculture and the Environment*

Some of the most pressing environmental issues in Azerbaijan include: pollution of water resources with wastewater, including tranboundary pollution; insufficient quality water and sewer lines in populated areas; degradation of fertile soils due to erosion, salinity, etc.; and biodiversity decline.[3]

Water resources are unevenly distributed across Azerbaijan. The Kura-Araz Lowland, Gobustan-Absheron, Ceyranchol, and Nakhchivan have particularly low access to permanently running rivers. According to Aquastat and the Second National Communication to the UNFCCC, total water resources of Azerbaijan are about 39 km^3, of which about 29.3 km^3 are surface waters and 8.8 km^3 are groundwater. Even with a shortage of water, a quarter of water drawn was lost in delivery in 2005. Additionally, insufficient precipitation and uneven distribution over the year are problems for agriculture.

One response to water shortages in the agriculture sector has been a heavy reliance on irrigated agriculture – today more than 80% of the value of agricultural product is grown on irrigated lands.[3]

Although the agricultural sector in Azerbaijan produces a significant amount of waste, there exists no specific system for its collection and use.[3] As a result, agricultural wastes become an environmental problem. [3] Farmers dispose of waste on their own and, in many cases, end up polluting air and water resources.[3] Soil erosion is another problem, affecting about 42% of all land in Azerbaijan.[16] Other issues include: soil salinization due to poor management and deteriorated irrigation and drainage infrastructure; chemical soil pollution from fertilizers and pesticides; and degradation of pastureland from overgrazing.[16]

Soil degradation occurs on a large portion of land suitable for agriculture due to erosion, salinity, bogging, chemical pollution and more.[3] Figure 9 shows the percentage of total degradation due to human activities, and due specifically to agriculture. Comparing the relative height of the blue bars in Figure 9, it is apparent that in Azerbaijan 96% of human-induced degradation is due to agricultural activities, whereas in Europe as a whole (the red bars), this figure is only 23%.[11] Erosion affects 3.7 million ha within Azerbaijan, 0.7 million ha of which are intended for agriculture. Erosion is naturally caused from wind, water, gullies and irrigation, but also through lack of proper land management, poor cultivation practices, over grazing, reduction of forests and vegetation, and other human factors. Salinization of irrigated lands is also a major problem, and some severely salinized lands can no longer be cultivated.

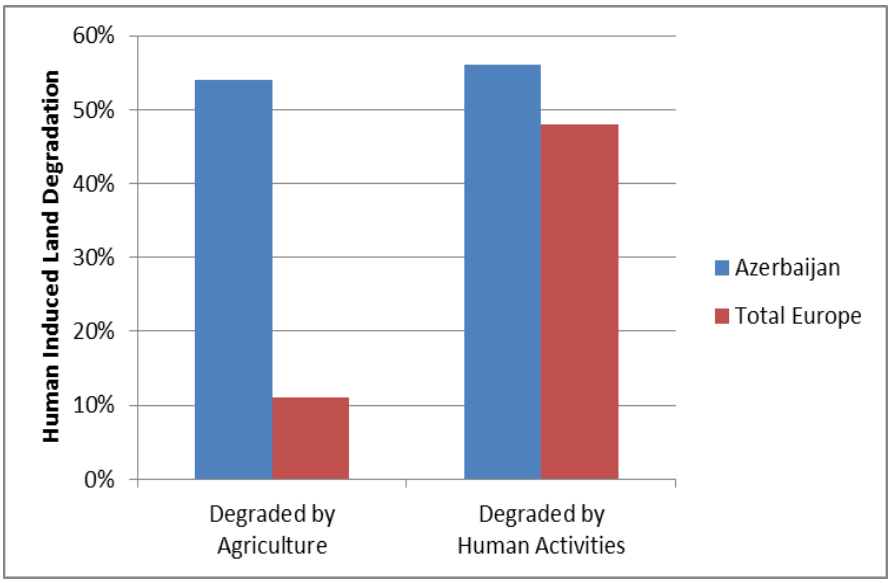


Figure 9: Land Degradation by Type, as a Percent of Total Land Degradation
Sources: FAO Land and Water Development Division TERRASTAT http://www.fao.org/ag/agl/agll/terrastat/

Flooding affects 300 km^2, and every other year washes out up to 1 million m^3 of soil and causes significant damage. Mining operations and other human impacts result in another 30,000 ha of land being unusable for cultivation. Overall, only 49.3% of Azerbaijan's total 8.6 million ha of land area are suitable for agriculture.[3] Economic effects of these events are substantial in Azerbaijan. From 1978 through 1995, Caspian Sea floods and coastal erosion caused damages of two billion USD in Azerbaijan; in July 1997, floods and erosion cost Azerbaijan 50 million USD; and from 2000 through 2007, floods and erosion cost Azerbaijan 490 million USD in damages.[28]

Within the Caucasus region, Azerbaijan has especially diverse natural resources. The range of landscape types that help promote this diversity across Azerbaijan are shown in Figure 10. However, diversity of plants and animals is at risk due to anthropogenic impacts. Activities affecting Azerbaijan's flora and fauna include: unregulated grazing for sheep and cattle; harvesting rare and medicinal herbs; poaching; and logging for fuel.[3]

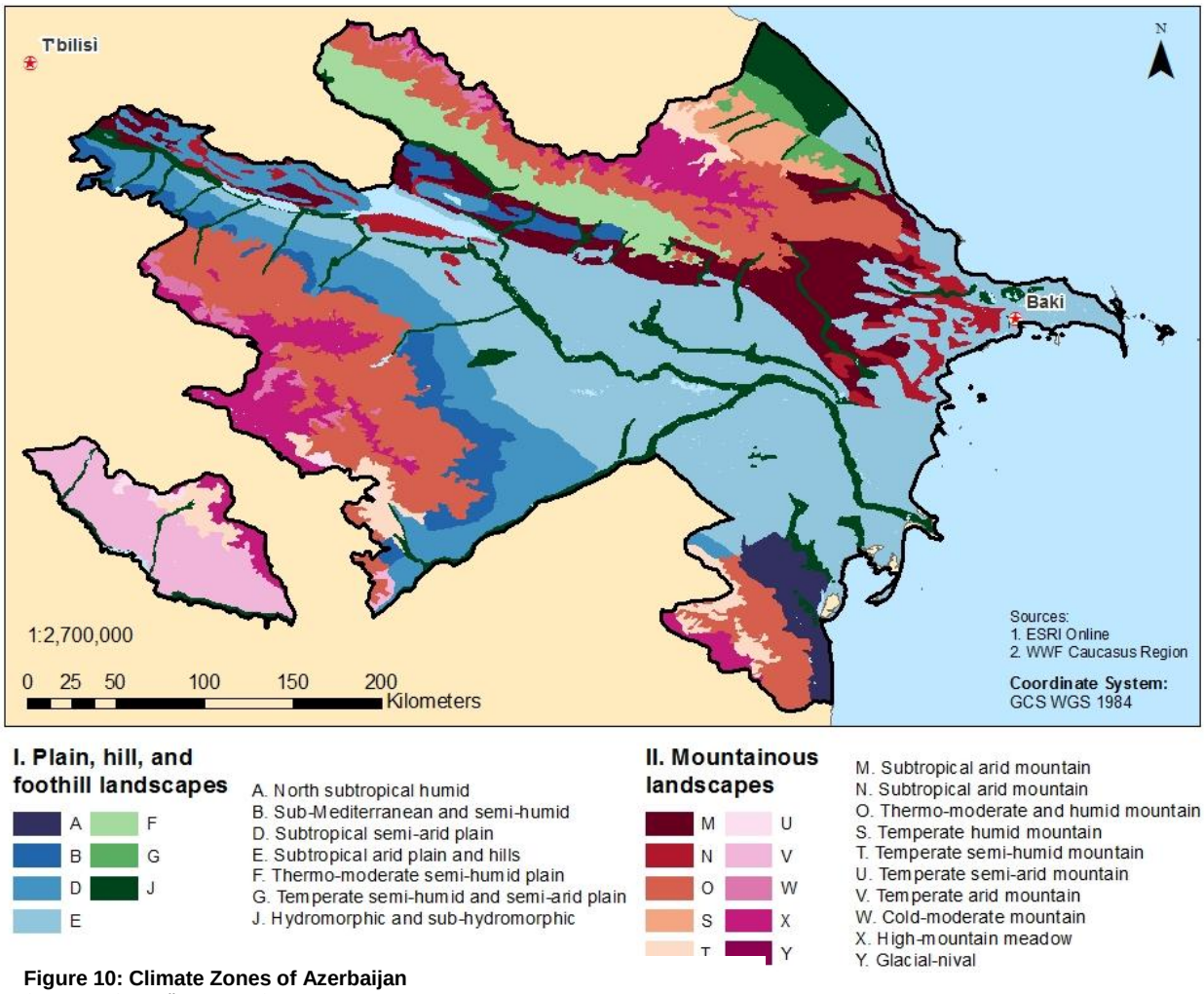


Figure 10: Climate Zones of Azerbaijan
Sources: ESRI online, WWF Caucasus

Azerbaijan can be divided into four agricultural zones based on the spatial distribution of elevation, irrigation, agricultural lands, livestock density, pasturelands, temperature and precipitation. Figure 11 shows these four agricultural zones, which have significant differences in topography, temperature, humidity and precipitation from the surrounding region. The four zones are: high rainfall (dark blue), irrigated (light blue), low rainfall (light green), and subtropical (dark green). The high rainfall region encompasses the majority of western and northern Azerbaijan. The central zone is irrigated, the east has low rainfall, and the southeast is subtropical. Nakhchivan is split between high rainfall and irrigated areas.

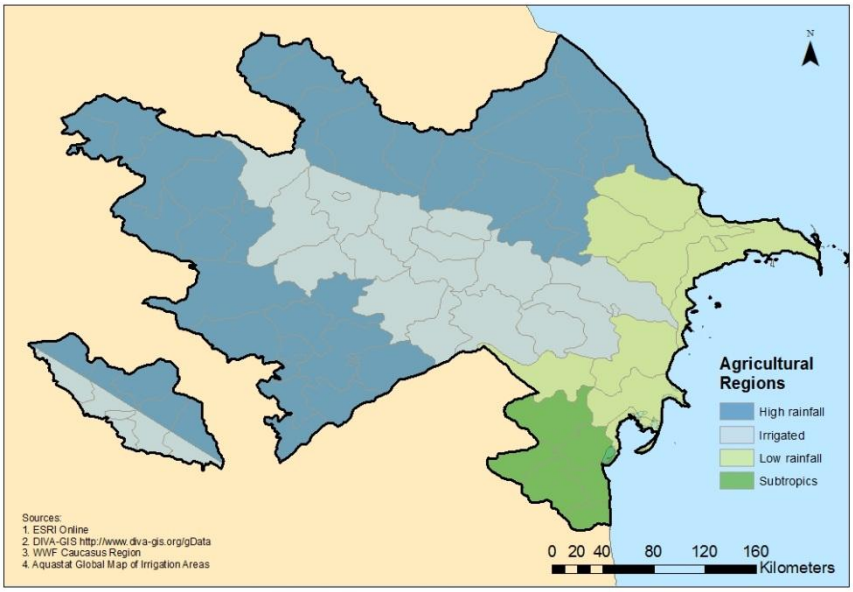


Figure 11: Agricultural Zones of Azerbaijan
Sources: ESRI online, DIVA-GIS, WWF Caucasus Region, and IEc Analysis

VI. *The Climate Context*

Climate Description

Azerbaijan is on the northern edge of the subtropical zone, and has a continental climate.[8] Generally speaking, most of Azerbaijan is characterized by mild winters and moisture scarcity in the summer, with continuous droughts.[3] Beyond that, the climate varies significantly with location. Temperatures in low-lying areas, in the east and between the mountains, range from 25 to 27°C in the summer and 3 to 6°C in the winter.[7] In general, these lowlands are considered semi-deserts. In the highlands, the temperature does not exceed 5°C in the summer and ranges from -3 to -5°C in the winter.[7] Average precipitation is 447 millimeters per year.[8]

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.[6] UNFCCC reported climate trends in the periods 1961 through 1990 and 1991 through 2000. Temperatures increased 0.34°C in the period from 1961 to 1990, and increased an additional 0.41°C in the ensuing decade. For the past 10 years compared to the 1961 to 1990 baseline, rainfall levels fell by 14.3% in Kura-Araz Lowland, 2.6% in Guba-Khachmaz region, 6.4% in Shaki-Zagatala region, 17.7% in Ganja-Gazakh, 1.7% in Nakhchivan, and 1.2% in the Southern region, with overall reductions of 9.9% across the country.

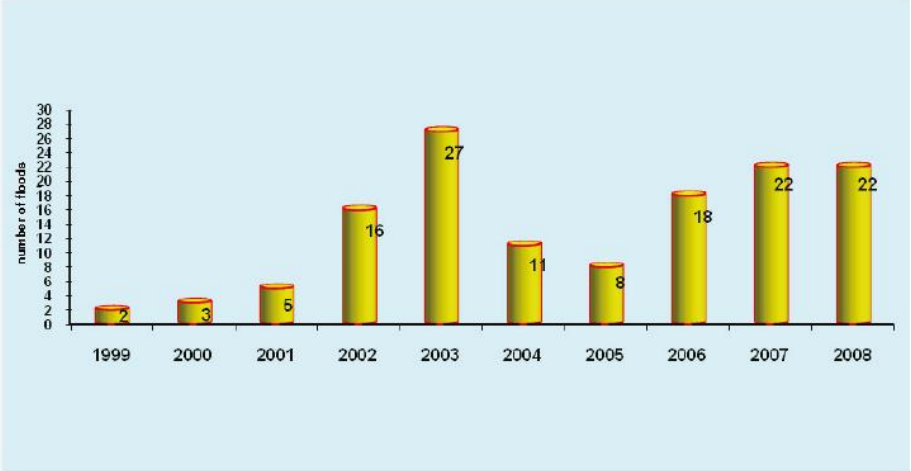


Figure 12: Trend of Floods 1999 to 2008
Source: UNFCCC Second National Communication

While water shortages exist in Azerbaijan during the low water seasons, inundations and flash floods are common in the high water season. The frequency of these extreme events has been increasing in recent years, as can be seen in Figure 12.[3] Additionally, an analysis of extreme events in Azerbaijan found an increasing trend in the number of days per annum with minimum daily temperatures over 20°C in all three stations analyzed, and an increasing trend in the number of days per annum with maximum daily temperatures over 25°C in one of the three stations analyzed.[28] Around 500 km^2 of coastal areas in the country have been subject to flooding since 1978 due to rising levels of the Caspian Sea. Economic damages due to flooding events amount to 2 to 2.5 billion USD, including damage to 40,000 ha of winter pastures and 10,000 ha of irrigated lands.[3]

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, and 94% of the glaciers retreated 38 meters per year.[18] In Azerbaijan, the main glacier areas are in Gusarchay Basin in the Greater Caucasus. The area of glaciers has decreased from 4.9 to 2.4 km^2 in the past 110 years. Natural water resources are declining, and therefore, water shortages are becoming more frequent. Most water shortages are currently due to leaks in distribution systems, which might become even more problematic in the future.[3]

Climate Projections

The mean temperature in the country is expected to continue to rise, but precipitation may increase, as estimated by application of the PRECİS 1.4 model, and as can be seen in Figure 13.[3] The Second National Communication forecasts a cumulative temperature increase over the period from 2021 to 2050 of 1.50 to 1.60°C. Additionally, precipitation is forecast by the PRECIS model to increase by 10 to 20 percent by 2050 compared to the 1961 to 1990 baseline level (see Figure 14).[3] World Bank analyses, relying on a broader range of climate models, indicate temperature increases could range from 1.4^{o}C to 2.8^{o}C in 2050, and that precipitation may be just as likely to decrease as increase.[35]

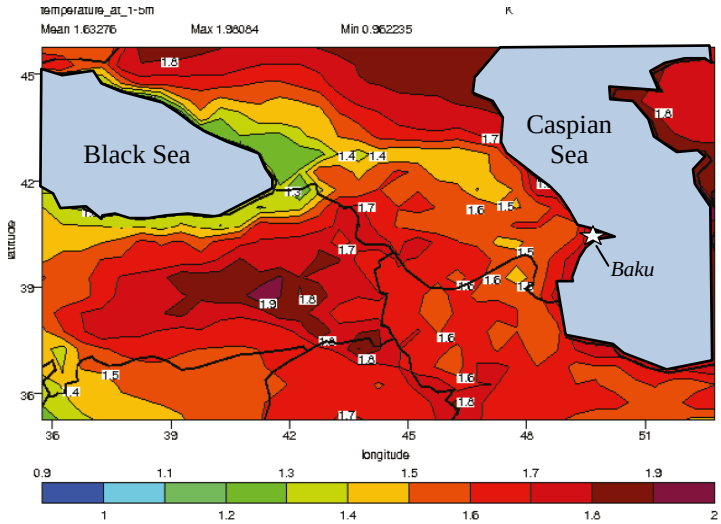


Figure 13: Average Annual Temperature Increase in the Region (Difference Between 2021 to 2050 and 1961 to 1990)
Source: UNFCCC Second National Communication

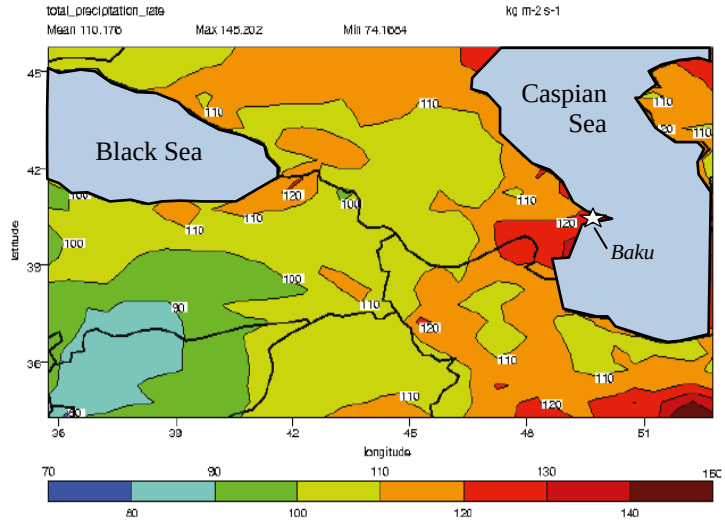


Figure 14: Rainfall Changes (2021-2050 Compared to the 1961-1990 Period in %)
Source: UNFCCC Second National Communication

The change in climate is expected to stress water resources. Surface water is predicted to decrease by 23% from 2021 to 2050, and water resources are predicted to decrease by 29% from the baseline year level from 2071 to 2100. These changes reflect a combination of changes in precipitation and temperature (temperature increases cause drying via evaporation). This could lead to water shortages three to four times higher than in the baseline year.

Other important aspects of the climate are also expected to change. Due to warming, weather zones may move upward in elevation 150 to 300 m by 2021 to 2050, and 450 to 950 m by 2071 to 2100. Evaporation (which is most directly influenced by temperature changes) is forecast to increase by 15% over the baseline year level by 2050. Combining estimates of changes in evaporation with estimates of changes in rainfall provides a measure of aridity called climatic water balance – this measure is displayed in Figure 15.[3] As indicated in the figure, in most of the central and northern part of Azerbaijan, increased evaporation will limit increases in climatic water balance, leading to a net effect of increased drying, an outcome which could be important for the growth of crops and vegetation in future periods.

Additionally, some ecosystem changes expected to occur with climatic shifts include: increase in the extension of semi-desert and dry steppe areas by 2.4 to 3.4 times; increase in erosion by 10 to 15%; decrease of river flow by 10 to 20%; reduction in rainfall during spring and summer, and increases in rainfall in autumn and winter; increase in current water deficit from 5 km^3 to 11-13 km^3 due to the combined effects of changes in temperature and precipitation on both water demand and supply; and increase in salinization in the Kura-Araz lowlands by 10 to 15%.[6]

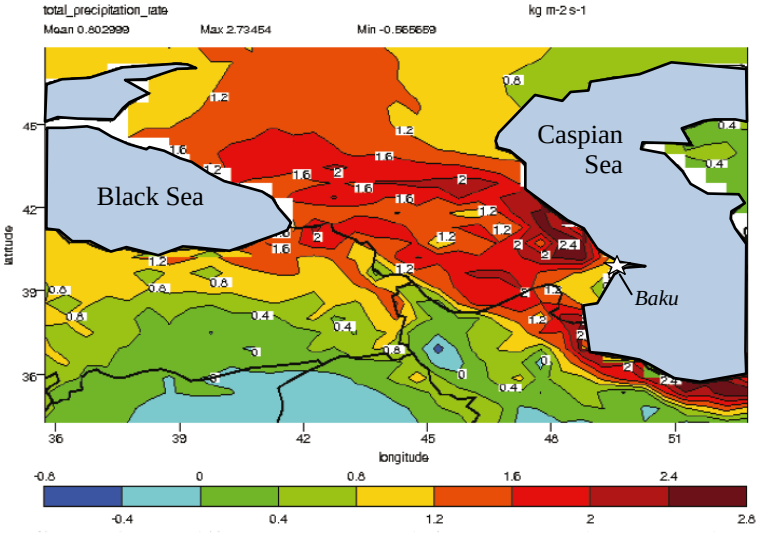


Figure 15: Change in the Difference between Rainfall and Potential Evaporation within the Scenario Period Compared to the Baseline Period (mm per day)
Source: UNFCCC Second National Communication

Climate Change Vulnerability Index

While climate change in Europe, the Caucasus and Central Asia is expected to result in high temperatures, droughts and reduced water resources, economies in transition and least-developed nations are expected to be disproportionately affected. It is also most difficult for these countries to adapt due to poverty levels.[3] 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 to 2099 period relative to the 1961 to 1990 period. The vulnerability index displayed in Figure 16 is a combination of the exposure, sensitivity and adaptive capacity indices. The vulnerability of Azerbaijan to climate change based on this index is near the middle range of countries in the World Bank ECA region. The main underlying drivers of vulnerability identified for Azerbaijan were the limited adaptive capacity and particular social and productive structures, which enhance the sensitivity of Azerbaijan to climate change.[10]

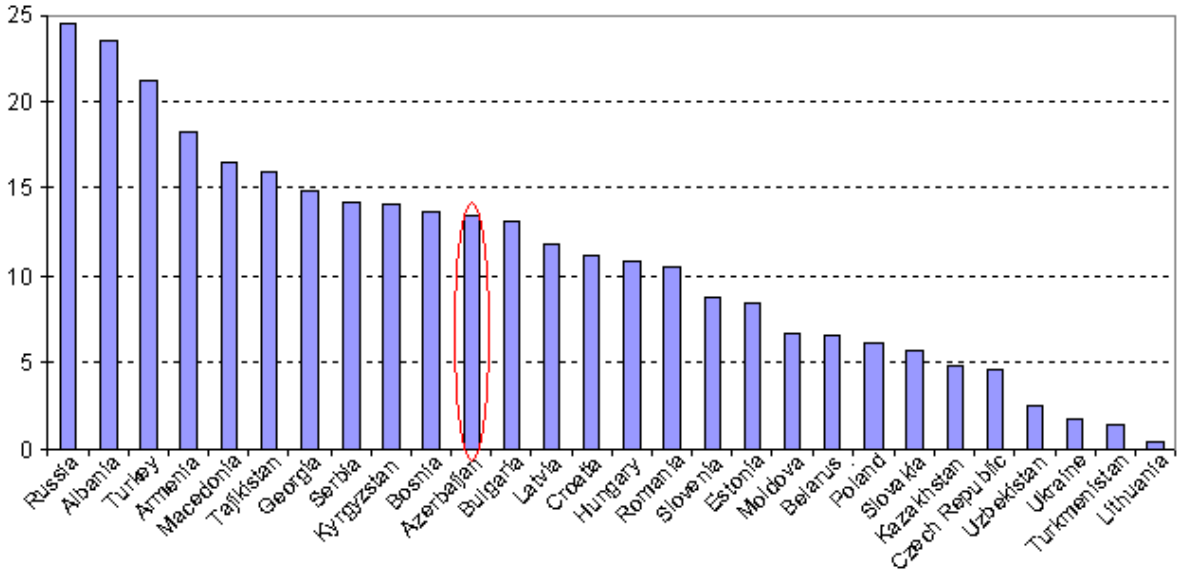


Figure 16: Climate Change Vulnerability Index, ECA Region
Source: The World Bank, 2009. Adapting to Climate Change in Europe and Central Asia, Washington DC

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

Agricultural Risks and Opportunities

Changes in climate, including increased evaporation, changes in precipitation, increasing temperatures, and more are important considerations in agricultural production. These changes will benefit some crops and harm others.

Projected Crop Yield Impacts

Crop production and timing are expected to change with climate change. In some cases, the changes in climate could positively impact the production of certain crops, while others are limited by various environmental factors:

- **Cotton**: Current low productivity in cotton is due to lack of access to fertilizers, high quality seeds, chemical substances, and equipment, and soil conditions and water supply are frequently inadequate. Warming and the decrease in moisture shortages are expected to have a positive impact on cotton crops. Currently used medium-ripening varieties could be replaced with better quality late-ripening long fiber varieties. Heat loving, late-ripening varieties will be favored in a warmer climate; however, the predicted increases in precipitation may coincide with the ripening period, in which case losses could be experienced. Productivity of cotton plantations is forecasted to increase by 4 to 5% in the later part of the century (2071 to 2100) compared to an earlier forecast period (2021 to 2050). With a combination of the effects of climate change and remedying the insufficiencies in current cotton plantations, productivity could increase in the future.[3]

- **Wheat**: The effects of climate change on winter wheat productivity vary. While the potential length of vegetation in currently planted areas will increase, the actual vegetation period could decrease by 20 to 25 days by 2050 compared to the baseline. Sowing of forage, melons, greens, etc. after earlier wheat harvests could be possible. though these changes are dependent on water supply. In the future, wheat could be grown at higher altitudes due to rising temperatures; however, possibilities for adopting this adaptation measure might be limited due to insufficient suitable land areas.[3]

- **Vineyards**: Most industrial vineyards are located at elevations of 800 to 900 m, even though the upper boundary extends to 1100 to 1300 m based on the thermal conditions of vegetation. In the period 2021 through 2050, vineyards may increase in elevation 200 to 450 m from their current location. In 2071 through 2100, the most favorable conditions may be at 1,400 to 1,700 m elevation. Like winter wheat, there may not be suitable land at these elevations, which would reduce growth of vine cropping. Harvest on fallow vineyards could increase by 4 to 5 times from the baseline to the 2021 to 2050 period. The level of sugar in grape juice is expected to increase by 2 to 3% by 2050 and 6 to 7% by the end of the century. Acidity may slightly increase in grape juice.[3]

- **Winter pastures**: Changes in climate are expected to positively impact winter pastures; however, the range is not likely to expand, and might even decrease. The decrease in area available could be due to trends in factors unrelated to climate change, particularly erosion and increasing land use for crops. Currently, productivity is reliant on the natural moisture level in soils, so precipitation predictions are important in assessing future productivity. Projected increases in rainfall may increase productivity in winter and spring grazing in both the mid- and late 21st century periods; however, increased moisture shortages in the late century period may prevent further increases in productivity.

- **Summer pastures**: The area of summer pastures could potentially expand with a changing climate; however, the limited nature of suitable lands may not allow for a significant change in area. Productivity is expected to be affected in areas with humid and extremely humid conditions since increased rainfall levels will have little effect on growth. Productivity could, however, be impacted by erosion processes that become more intensive with increased rainfall.[3]

Eighty percent of agriculture in Azerbaijan is produced in arid and semi-arid parts of the country, and over 80% of the value of agricultural output comes from irrigated land, so food production could decline with climate change, particularly as water resources could become more limited. Integrated agriculture and water resources analyses, combining crop yield and water resource availability estimates, could provide better insights about future productivity potential of irrigated lands with climate change.

Projected Water Resources Impacts

Most freshwater in Azerbaijan originates from rivers, 69 to 72% of which is from Georgia, Armenia, Turkey, Iran, and the Russian Federation. Untreated water released into the Kura River reduces hydrochemical quality and conditions in Azerbaijan, with copper, zinc, phenol, and oil products found in national rivers. [3]

Between 2021 and 2050, compared to the baseline years (1960 to 1990), the volume of reservoirs in Azerbaijan is expected to fall by 23% (22.5 km^3) and, between 2071 and 2100, reservoir volumes are expected to fall 29% compared to the baseline period.[3] Specifically regarding stream flow, reductions of 26 to 35% and 59 to 72% are expected in stream flow in the Alazani (Ganikh) and Agstafa basins, respectively, by 2100.[5] As a result, between 2071 and 2100, water shortage is expected to be 3.5 to 4 times higher than under the baseline.[3] More specifically, in the Belakan region of Azerbaijan, irrigation water requirements are expected to increase from zero today to about 50 mm and 110 mm for spring wheat and pasture by the end of the century.[5] Today, water shortages usually stem from problems with the distribution system (leaks, etc.) and if these inefficiencies are not fixed, the situation likely will worsen.[3] Continuing into the future, agriculture, hydropower and water supply will be the most vulnerable sectors. Water shortages are expected over 250,000 to 300,000 ha, which could lead to a decline in crop yields. Water per capita could decrease by over 60% and continued pollution could worsen this situation. [3]

Potential impacts on the Livestock Sector

Effects on pasture land will have indirect impacts on livestock. As indicated above, predicted climatic stresses can change the composition of pasture land. For example, flooding events have previously caused large damages to winter pasture, and flooding is expected to increase with climate change. Temperature and precipitation increases may increase pasture productivity in the near-term. however, moisture shortages and further increases in temperature may decrease productivity further into the future. Additionally, the area suitable for winter pasture may decline.[3]

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

A variety of adaptations are recommended directly in the agricultural sector, and indirectly to preserve water resources, address coastal zones, and improve education. The following are examples of an initial set of adaptation measures that attempt to lessen the negative impacts of climate change on agriculture, as identified in Azerbaijan's Second National Communication:[3]

- Introduce plant varieties that are thermophilic, drought resistant, and productive, especially for winter wheat and cotton;
- Plan for interventions against soil salinity, erosion, and drought;
- Apply water-saving technologies in irrigation;
- Improve storage systems for agricultural products;
- Create small processing plants for perishable products in villages;
- Implement government programs to encourage growth in manufacturing competitive products through processing plants in the agricultural sectors; and
- Restore vineyards and orchards, and expand or create new areas on lands suitable for these crops.

Water resources and coastal zones are also particularly important to address in adaptations to climate change, as 30% of agricultural lands are irrigated), and flooding along the coastline affects 40,000 ha of winter pastures and 10,000 ha of irrigated lands. The following are some adaptation measures addressing water resources in Azerbaijan, as identified in the country's Second National Communication:[3]

- Improve the water resource management system including reducing water leakages;
- Use additional sources of water;
- Use hydrologic cycle water, including groundwater;
- Regulate flows;
- Clean river channels;
- Strengthen protection against inundations and flash floods;
- Reduce water losses and improve supply networks;
- Restore and reconstruct water channels and watering and drainage systems; and
- Construct small hydroelectric stations on mountain rivers and existing irrigation channels, to improve water storage capacity, and construct new water storage facilities.

These measures, identified in Azerbaijan's Second National Communication, have not yet been evaluated for their crop yield and economic benefits. Analysis that combines crop yield and water resource balance analysis with economic estimates of the costs and benefits of these measures would be valuable as a priority-setting tool for Azerbaijan.

Climate monitoring already exists in Azerbaijan, but could be improved. Climate monitoring began in the country between 1830 and 1847 with more than four meteorological stations. Additionally, the Caspian Sea level has been monitored since 1830 and the Kura River hydrological regime started in 1888. By 2000, there were 77 meteorological posts, 100 hydrological and 12 marine stations. Agricultural crops were monitored at 46 posts.[3] Currently, the Hydrometeorological Department of Ministry of Ecology and Natural Resources (MENR) conducts meteorological, agrometeorological, hydrological and oceanographic observations, and the Monitoring Department of MENR conducts environmental pollution monitoring of soil, water, and air. The State Amelioration and Water Management Open Stock Company (OSC) conducts hydrological monitoring of lakes. The meteorological surface observation network of Azerbaijan includes 78 stations,. Of these, 58 stations provide climate information to the public and all observations are based on World Meteorological Organization (WMO) best practices. Some observations that do not yet exist in the country include CO_2 emission monitoring and increased biomass and forests.[3] In some cases, a regional, multi-country approach to monitoring of key climatic conditions may be most cost-effective.

In terms of climate effects on water resources, some suggestions have been made for adaptation options. In the area of climate monitoring for water resource management, 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, multi-country 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, plowing, and seeding of degraded areas with new seed types, and remove stones in pastures; (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. Extension and research should also play a role - the rate of return to investment in research and extension for agriculture is often high.[5]

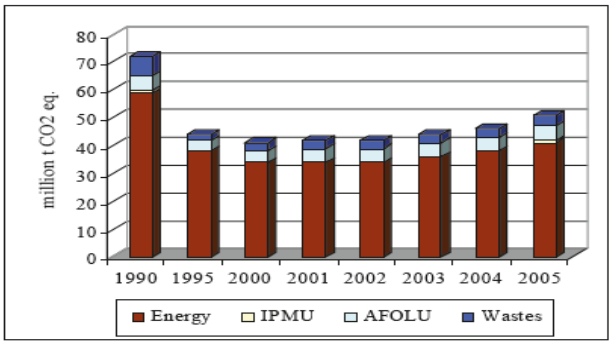
IX. *Impacts of Agriculture on Greenhouse Gas Emissions*

There have been a variety of programs to address greenhouse gas emissions. Programs relating to agriculture that existed in 2000, as of the first national communication, included: a state program on macroeconomic stabilization, a plan for irrigation and water economy with agrarian reforms, the National Environmental Action Plan, Afforestation Program, and the Programming on Restructuring and Financing of Agriculture.[7] In Azerbaijan, in 2005, 9.5% of total greenhouse gas emissions were derived from agriculture, compared to 8.9% in Europe overall.[19] Over a third of methane emissions are derived from agriculture, including enteric fermentation, and manure, and of nitrous oxide emissions mainly through the use of nitrogen and mineral fertilizers, and decomposition of plant residue on agricultural soils.[7] Methane emissions from internal fermentations of domestic animals increased from 1994 through 2005, with 2005 emissions at 221.5 Gt. This growth is due to increasing herds of cows, buffalos and sheep. Similarly, methane emissions from manure of domestic animals increased from 1994 through 2005, with 2005 emissions at 25.5 Gt.[3]

A 70.6% decline in greenhouse gas emissions between 1990 and 2005 resulted from the decline in industrial activities after 1990. In 1990, 71.1 million tons of CO_2 were released while in 2008 only 50.6 million tons CO_2 were released. These temporal trends and the breakdown of greenhouse gas emissions by sector are show in Figure 17, where AFOLU is the sector of agriculture, forestry and land use.[3]

Mitigation Potential in Agriculture

Particularly important sources of greenhouse gas emissions in the agricultural sector are CH_4 and N_2O. The breakdown of methane emissions in Azerbaijan by sector and over time are show in Figure 18 (AFOLU is agriculture, forestry, and land use). Methane emissions have increased in recent years, but N_2O emissions (mainly from nitrogen fertilizers, have declined substantially in recent years.[3]



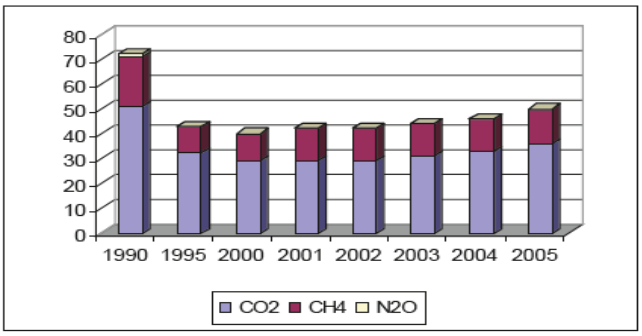


Figure 17: Greenhouse Gases by Gases and by Sectors
Where AFOLU is agriculture, forestry, and other land use
Source: UNFCCC Second National Communication

Some examples of mitigation measures in the agricultural sector, and their relative cost, are shown in Figure 19. While restoring organic soils in cultivated lands has the largest mitigation potential overall (dark green bar), there are many options related to cropland management that are less expensive (light green bar).[30] One specific mitigation strategy noted in the second national communication is recovering methane from animal waste and sewage to produce energy.[7] The Ministry of Ecology and Natural Resources installed pilot projects of biogas facilities in four regions to raise public awareness. The Ministry of Agriculture is also promoting facilities to produce biogas from manure. Processing dry wastes from agricultural plants is also noted to reduce greenhouse gas emissions.[3]

The National Programme on the Rehabilitation and Expansion of Forests of 2003 includes plans to reforest 69,000 ha including 44,700 ha of newly planted forests, recovery of 25,000 ha, and planting 14,300 ha of greenbelt along new highways and railways, in lowlands, around ponds, and in coastal areas.[3] These measures have the potential to increase carbon storage in soils and vegetation.

Carbon Trading and Agriculture

The Clean Development Mechanism (CDM) allows developed (Annex I) countries to implement mitigation projects in (non-Annex I) countries in order to instigate investment and promote transfer of environmentally friendly technologies. On April 1, 2005, the President appointed the Ministry of Ecology and Natural Resources as the National Focal Point (NEP) for enhancing participation of the nation in the CDMs of the Kyoto Protocol.[3] EU funding has supported the start of CDM work in Azerbaijan. UNDP and financial support from the Norwegian Government helped start a two-year project in July 2006 to assist development of CDM projects, including designation of priority sectors.[6]

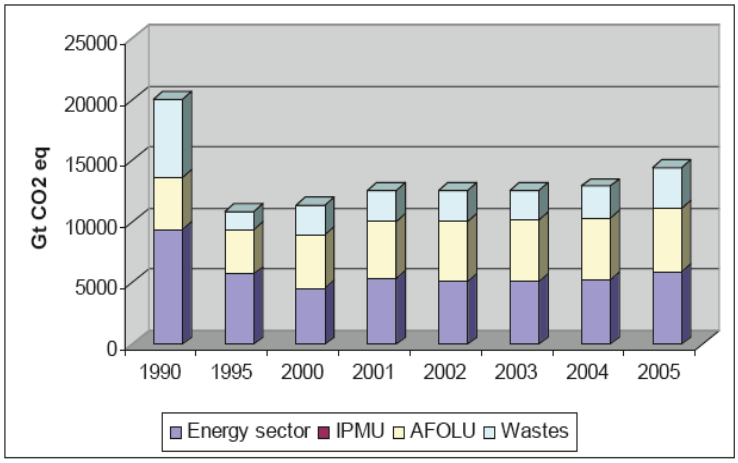


Figure 18: Methane Emissions
Source: UNFCCC Second National Communication

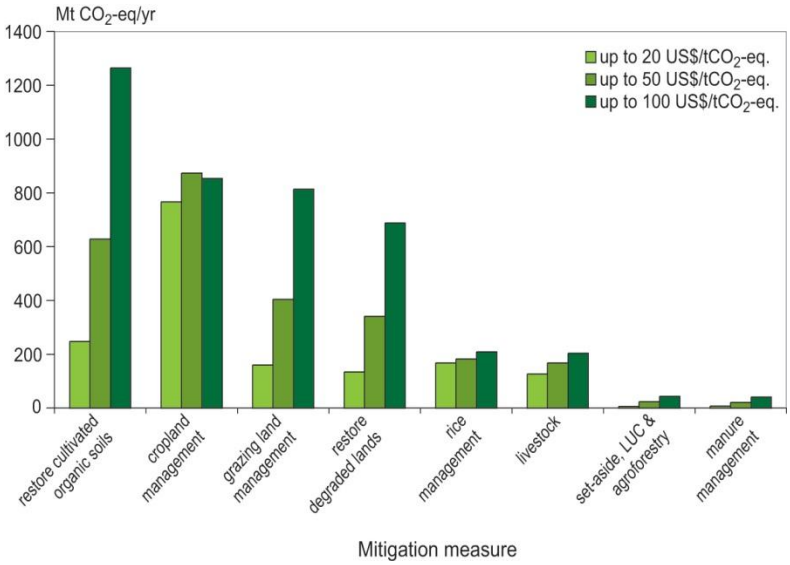


Figure 19: Potential for Agricultural Greenhouse Gas Mitigation (excluding bioenergy and improved energy efficiency) at a Range of Prices of CO_2-eq
Source: Smith, P. and Martino, D. 2007. IPCC Fourth Assessment Report: Climate Change 2007 (AR4). Working Group III Report, "Mitigation of Climate Change."

CDM projects started in Azerbaijan after the Kyoto protocol took effect in 2005. The Ministry of Ecology and Natural Resources have signed agreements for CDM cooperation with Denmark and Germany, and similar agreements with other countries are pending. The following 34 project proposals have been submitted in the Energy, Agriculture, Forestry and Waste sectors for approval:[3]

Sector	Number of CDM project proposals	GHG reduction rates (1,000 tons/year CO2 equivalent)
Energy	17	13,675.4
Alternative Energy	9	1,775.0
Agriculture	2	3,331.0
Wastes	3	287.1
Forestation and afforestation	3	62.7
Total	**34**	**19,131.2**

While there are currently only two proposals submitted in the agricultural sector, the potential for adaptation measures (e.g., conservation agriculture and other land productivity increasing measures) to provide both mitigation of GHG emissions and short-term yield enhancement may be high – a comprehensive analysis of these measures is needed to support more widespread adoption of measures that may have a win-win-win quality, simultaneously providing yield, climate resilience, and GHG mitigation benefits.

X. *The Policy Context*

The First and Second National Communications of the Republic of Azerbaijan 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 was created from 1998 through 2000, a period of economic crisis. Therefore, many agencies were not operating, and much data is uncertain, such as greenhouse gas emissions and potential abatement measures. The Second National Communication analyzes Azerbaijan's situation, accounts for greenhouse gas emissions, predicts future climate scenarios, evaluates the vulnerability of sectors and ecosystems within the country, and identifies potential adaptation measures. The Second National Communication therefore provides an excellent launching point for further work on adaptation in the agricultural sector.[3]

Within the country, there have been some programs addressing improvement of the productivity of agriculture. The State Program on Poverty Reduction and Sustainable Development in the Republic of Azerbaijan for 2008-2015 was instated in response to the United Nations Millennium Summit committing to achieve poverty reduction by 2015. Goals of this program, along with the State Program on Secure Food Supply to the Population in the Republic of Azerbaijan, include improving agricultural sector productivity and food security.[32] Additionally, the State Program on the development of the vine-growing in 2012-2020 in the Republic of Azerbaijan was approved in 2012, and three projects have already been financed by the National Fund for Entrepreneurship Support.[33] In general, a key issue in this context is that laws and policies are well-thought out, but enforcement and implementation can be inadequate, owing to limitations in resources, capacity, outreach, and/or relevant knowledge.

International Support,, Strategies, Programs and Analytical Studies

Various international and regional plans exist for adapting to and mitigating the effects of climate change. There exists a Regional Programme for Food Security (RPFS) for the Economic Cooperation Organization (ECO) member states, which includes Azerbaijan. Additionally, the Emergency Prevention System for Transboundary Animal and Plant Pests and Diseases (EMPRES) also has two agriculturally related projects. The first component relates to animal health, addressing the Highly Pathogenic Avian Influenza (HPAI) crisis in Asia. The EMPRES central Asian regional network promotes methods of fighting HPAI. The Animal Health component of EMPRES also provides assistance in assessing African Swine Fever in Azerbaijan. The Desert Locust Component of EMPRES addresses locusts, which are one of the most serious agricultural pests in the country - outbreaks occur frequently.[9]

Azerbaijan became eligible to connect with several international observation systems after joining WMO and acceding to various conventions. One station in Astara (GJOS/GSN) has access to the Global Surface Observation Network. Azerbaijan is also a member of the CIS intergovernmental hydrometeorological network, and participates in data exchange with neighboring countries.[3]

Azerbaijan has made efforts with other countries and international agencies to achieve greenhouse gas mitigation goals. Memoranda of understanding were signed with the Governments of Denmark and Germany on expanding vegetation cover, and on capacity building for mitigation. Additionally, Azerbaijan has taken part in the following international and regional programs that may be relevant for the agricultural sector:[3]

Organizations	Programs	Years
UNDP, GEF	Preparation of Initial and Second Communications.[9]	2001, 2010
USAID	*Participatory Agriculture Project in Azerbaijan (PAPA) Program* aimed to develop the private agricultural sector through increased profitability of businesses, ensuring support, expanding value added processing, and increasing access to market information.[20]	2000-2003
USAID	*Azerbaijan Rural Credit Project* aims to create a rural credit cooperative system for small to medium-sized loans in the agricultural sector on a sustainable basis, and to increase economic viability and sustainability of private agricultural enterprises.[20]	2000-2005
USAID	*Agro-Input Market Development in Azerbaijan* included development of an agro-input supply system through creating a network of over 80 agro-input dealers that help transfer modern practices and technology to farmers.[20]	2002-2005
USAID	*Small and Medium Enterprise Finance Program* helped small and medium enterprises and other economically active individuals to access commercial loans and financing.	2002-2005
USAID	*Cluster Access to Business Services in Azerbaijan* improved profitability for clusters of rural poor and women micro-entrepreneurs by improving access to trained veterinary and production advice service providers in order to increase the service and final goods markets.[20]	2002-2007
USAID	*Azerbaijan Rural Enterprise Competitiveness Program* stimulated agricultural development and production to improve rural incomes.[20]	2003-2008
World Bank	*Azerbaijan Farm Privatization Project (FPP)* aims to restructure six former collective and states farms and to transfer their assets to local populations.[21]	2004
EU TACIS	Technical Assistance to the Caucasus Countries and Moldova on the Fulfillment of Commitments on Global Climate Change	2004-2006
USAID	*Regional Water Management Project* provided technical assistance through strategic work with key public and private sector stakeholders, including with Ministry of Ecology and Nature Resources and Amelioration JSC.[20]	2005-2008
International Fund for Agricultural Development (IFAD)	R*epublic of Azerbaijan Integrated Rural Development Project (IRDP)* aims to enhance natural resource management to improve food security and to increase access of the rural people to profitable markets and value chains.[23]	2010
European Commission	AAP2008 Twinning projects, including strengthening Initial Vocational Education in the field of Agriculture.[24]	2011
European Investment Bank (EIB)	EIB, the World Bank, and the European Bank for Reconstruction and Development provide financial resources to central and eastern Europe. They aim to create a facility allowing investments in energy and environmental projects.	2009
Norwegian Humanitarian Enterprise	Agricultural Program created to help farmers with sustainable and independent agriculture. Projects include 15 farmer unions and 38 farmer groups organized, 30 greenhouses refurbished, over 80 training sessions, and more than 4,200 inseminations of cattle, benefitting over 15,300 farmers.[25]	2002-2012
World Bank	*Second Agricultural Development and Credit Project for Azerbaijan* aims to expand financial services for small and medium rural enterprises through credit unions and commercial banks, widens market development activities, include public/private nationwide information and advisory systems, and improve veterinary practices.[26]	2006-2012
REC Caucasus	Support Development of Biodiversity Conservation Policies and Practices in Mountain Regions of the South Caucasus.[27]	2011-2014
World Bank	*Water user's association development support project:* This project aims to improve the effectiveness and financial viability of on-farm irrigation, water distribution and management.[29]	2012-2016

XI. *The Institutional Context*

The four authorities in Azerbaijan responsible for land management and agricultural policy are the following:

1. **Ministry of Agriculture of Azerbaijan** is responsible for agricultural policy development;
2. **Ministry of Ecology and Natural Resources (MENR)** controls environmental policy;
3. **State Committee for Land and Cartography** establishes land reform (titles, cadastres, mapping, erosion control, pasture management, and salinity control); and
4. **State Agency Committee for Amelioration and Water Management** undertakes irrigation projects.

Cooperation among these authorities is necessary but currently limited, even though their functions and mandates are similar. National programs exist for soil protection, and land and water management. Some donor-supported projects for irrigation and drainage rehabilitation which were identified under the National Program on Environmentally Sustainable Socioeconomic Development for 2003 to 2010 exist. The Ministry of Agriculture of Azerbaijan has an Extension Support Center, but requires more training, technical assistance, and financial resources to run properly.[16]

There also exist agencies that are responsible for monitoring and research. The World Meteorological Organization conducts hydrometeorological observations, makes forecasts, assesses climate, agroclimate and water resources, and monitors changing trends. The **Hydrometeorological Department of MENR** carries out agrometeorological, hydrological and oceanological observations, and the **Monitoring Department of MENR** monitors environmental pollution in soil water and air. Hydrological monitoring in large and small lakes is done by the **State Amelioration and Water Management OSC**.

XII. *Ways Forward*

In March of 2012, an Awareness Raising and Consultation workshop on Reducing Vulnerability to Climate Change in Azerbaijani Agricultural Systems was held in Baku, Azerbaijan. During this event, a draft version of the Climate Change and Agriculture Country Note was disseminated and discussed 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 involves Azerbaijan working jointly with the World Bank to develop the Azerbaijani Response to Climate Change for Agriculture program. Broadly, this work involves further 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 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 Azerbaijani 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 Azerbaijani experts in developing an Agricultural Sector Climate Adaptation 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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XIII. *References*

1. CIA, The World Factbook: Azerbaijan, 2011. https://www.cia.gov/library/publications/the-world-factbook/geos/aj.html
2. World Bank. 2012. World Bank Indicators, Azerbaijan. http://data.worldbank.org/country/azerbaijan
3. UNFCCC. Second National Communication to the United Nations Framework Convention on Climate Change. 2010, Baku. Ministry of Ecology and Natural Resources, Republic of Azerbaijan.
4. Intergovernmental Panel on Climate Change. Fourth Assessment Report: Climate Change 2007. Working Group I Report "The Physical Science Basis." Note: World Bank consultant Industrial Economics, Inc. analyzed the data across the 56 available options to develop a mid-range scenario.
5. UNDP. 2011. *Regional Climate Change Impacts Study for the South Caucasus Region*. Tblisi, Georgia.
6. WWF Norway, WWF Caucasus Programme. July 2008. Sylven, M., Reinvang, R., and Andersone-Lilley, Z.Climate Change in Southern Caucasus: Impacts on Nature, People and Society. http://assets.wwf.no/downloads/climate_changes_caucasus___wwf_2008___final_april_2009.pdf
7. UNFCCC. Initial National Communication of Azerbaijan Republic under the United Nations Framework Convention on Climate Change, Baku 2000.
8. FAO, AquaStat, 2008 http://www.fao.org/nr/water/aquastat/countries_regions/azerbaijan/index.stm
9. FAO Countries: Azerbaijan, 2011. http://www.fao.org/countries/55528/en/arm/.
10. World Bank. 2009. *Adapting to Climate Change in Europe and Central Asia*.
11. FAO Land and Water Development Division TERRASTAT http://www.fao.org/ag/agl/agll/terrastat/
12. FAO. 2011. Food Security and Agriculture Highlights: Azerbaijan. http://www.fao.org/docrep/014/am598e/am598e00.pdf
13. Salt, J. 2005. Current Trends in International Migration in Europe. The Council of Europe, Paris. http://www.coe.int/t/dg3/migration/documentation/Migration%20management/2005_Salt_report_en.pdf
14. Aghayeva, Azru. Azerbaijan International. *Seeds of Change: Transition in Azerbaijan's Agriculture.* Autumn 2000 (8.3), 28-31. http://azer.com/aiweb/categories/magazine/83_folder/83_articles/83_agriculture.html
15. FAOSTAT. 2010. Production. http://faostat.fao.org/default.aspx?PageID=567#ancor.
16. World Bank Review: Integrating Environment into Agriculture and Forestry, 2007
17. European Union. Delegation of the European Union to Azerbaijan.
18. C.R. Stokes, S.D. Gurney, M. Shahgedanova and V. Popovnin, Journal of Glaciology (52): 99-109, 2006
19. WRI. 2011. Climate Analysis Indicators Tool (CAIT) version 8.0. Washington: World Resources Institute
20. USAID. 2012. USAID/Azerbaijan - Our Programs: Past Projects. http://azerbaijan.usaid.gov/node/86
21. Thurman, Michael. 2004. *Azerbaijan Farm Privatization Project*. http://info.worldbank.org/etools/docs/reducingpoverty/case/94/fullcase/Azerbaijan%20LandReform%20Full%20Case.pdf
22. Climate Change Consultant (Forestry). *Review of National Research, Data and Projects: Dimensions, Impacts and Mitigation and Adaptation Policies for Forestry Sector in Uzbekistan.* http://web.ogm.gov.tr/diger/forestandclimate/Dokumanlar/macaristanreports/Uzbekistan%20-%20Climate%20Change%20-%20Forestry%20ENG.pdf
23. International Fund for Agricultural Development (IFAD). 2010 *Republic of Azerbaijan Integrated Rural Development Project (IRDP) Project Design Report, Volume I: Main Report.* http://www.ifad.org/operations/projects/design/102/azerbaijan.pdf

24. ENPI. 2009. *Initial Concept Note: Potential Priority Areas for ENPI National Indicative Programme (NIP) for the Republic of Azerbaijan 2011-2013.* http://www.enpi-programming.eu/wcm/dmdocuments/Concept_note_for_Azerbaijan.pdf
25. Norwegian Humanitarian Enterprise. 2010. *Empowering rural communities of Azerbaijan through farming, community development and technology initiatives*. http://www.nhe-az.org/index.php/en/programs/agriculture.html
26. World Bank. 2006. *Second Agricultural Development and Credit Project In Support of the Second Phase Agricultural Development and Credit Program*. Report No: 36335-AZ. Europe and Central Asia. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2006/06/14/000160016_20060614104743/Rendered/PDF/36335.pdf
27. The Regional Environmental Centre for the Caucasus (REC Caucasus). *Support Development of Biodiversity Conservation Policies and Practices in Mountain Regions of the South Caucasus*. http://www.rec-caucasus.org/projects.php?lang=en
28. United Nations (UN). 2011. *Regional Climate Change Impacts Study for the South Caucasus Region*. Tblisi, Georgia.
29. World Bank. *Water user's association development support project*. Project ID: P107617. http://web.worldbank.org/external/projects/main
30. Smith, P., D. Martino, Z. Cai, D. Gwary, H. Janzen, P. Kumar, B. McCarl, S. Ogle, F. O'Mara, C. Rice, B. Scholes, O. Sirotenko, 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.
31. Personal Communication with Issa Aliyev at REC Caucasus. March 3, 2012.
32. Republic of Azerbaijan. 2008. State Program on Poverty Reduction and Sustainable Development in the Republic of Azerbaijan for 2008-2015.
33. Azerbaijan Republic National Fund for Entrepreneurship Support at the Ministry of Economic Development. 2012. Preferential credits granted to the entrepreneurs in Salyan. http://anfes.gov.az/en/news/85d8ce9a-53d9-11e1-a17c-001ec9df179b/10.02.12.html
34. The State Statistical Committee of the Republic of Azerbaijan (AZStat). 2011. http://azstat.org/indexen.php
35. World Bank. 2012. Climate Change Knowledge Portal. http://sdwebx.worldbank.org/climateportal/index

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