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OPPORTUNITIES AND CHALLENGES FOR A  
CONVERGING AGENDA: Country Examples



THE WORLD BANK

# **The Hague Conference on Agriculture, Food Security and Climate Change Opportunities and Challenges for a Converging Agenda:Country Examples**

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## 1. Introduction and Executive Summary

**The purpose of this paper is to summarize the challenges and the practical successes that a selected number of countries are experiencing in moving towards “climate smart” agriculture while addressing the needs of food security and broader development.** It complements papers on technologies and policy instruments (FAO), research (CGIAR), and farmer’s perspective (IFAP). The paper summarizes key messages and includes summaries of country experiences. The paper also looks briefly at how the broader policy environment affects country programs, at the newer financing instruments for both food security and climate smart growth, and the extent to which countries have been able to leverage and combine these.

**Countries were selected from every developing country region** including middle income export oriented countries (Uruguay, Brazil), middle income countries which are facing a range of challenges but which are also making progress in integrating climate into their agricultural strategies (China, Mexico), countries for which the greatest challenge is water stress, (Uzbekistan, Morocco), countries most heavily exposed to climate risks (Albania, Bangladesh), and lower income countries facing critical food security challenges (Niger, Yemen), or with diverse agricultural sectors (Kenya). More detailed country notes are provided in the Annex. The countries provide diversity in terms of income and agro-climatic challenges. Investing in climate smart agriculture provides the “triple win” of production systems which are more productive, more resilient and adapted to climate variability and change, and which contribute to carbon sequestration and reduced emissions.

**The main conclusion is that a number of countries have made impressive progress in “climate smart agriculture”.** They have created supported policy measures and programs to conserve soil and moisture while enhancing productivity and competitiveness (Brazil, Mexico, China), and have addressed the particular concerns of drought-prone semi-arid areas (Kenya), improved agricultural water management (Uzbekistan, Morocco), addressed watershed management (China, Albania), tackled the particular challenges of livestock (Uruguay, China), deforestation (Brazil), sea-surges and coastal flooding (Bangladesh).

**Food insecure countries face the greatest challenges of all** but have made progress in locally driven development initiatives in both social protection and soil and water conservation, which contribute to resilience. Combining these with support to early warning systems, enhanced agricultural productivity, and value added is a priority. Yemen, Niger and Northern Kenya are examples.

**Programs which have been successful have been implemented to scale, and over a substantial period, adapting and taking on new lessons as they progress.** Successful programs have benefited from strong local ownership and participation, often within decentralized government structures. Integrated landscape approaches have been key to success, together with support measures for managing weather risk, diversifying household income and improving market linkages. Private farmers have played a key role in innovation, especially where the enabling environment has been favorable.

**Within the broader policy environment,** secure land rights, a focus on research and knowledge dissemination, a pattern of public policy measures which favor sustainable land

and water management rather than price support or energy subsidies, and which provide an enabling environment for value added, commercialization and trade, all play a role. For the poorest countries productive social safety nets which support investment in land management are key, and some countries have achieved impressive results in this regard.

**A number of new funds have been developed** to support food security (GAFSP: Global Agriculture and Food Security Program), the food price crisis (GFRP: Global Food Crisis Response Program), climate resilient development (PPCR: Pilot Program for Climate Resilience), reduced deforestation/degradation (FIP: Forest Investment Program) as well as the Climate Funds supported by GEF and UNDP and other development partners. Development finance by partners such as WFP (World Food Program) and IFAD (International Fund for Agricultural Development) as well as foundations such as the Gates Foundation are also scaling up support for climate smart agriculture and agricultural research.

**There is growing recognition that since agriculture, including forestry, livestock and land use changes, account for over 30 percent of GHG (global greenhouse gas emissions), the sector needs to be included in future carbon market mechanisms.** Emissions reductions from improved livestock practices are eligible for carbon finance under the CDM (Clean Development Mechanism), while the work is well advanced for including REDD (reduced emissions from deforestation and forest degradation) in future CDM mechanisms. Soil carbon and carbon sequestration from improved agricultural practices are not yet eligible, however.

**The challenge and the opportunity for countries is to bring different funding mechanisms together and combine them with public, private and international development financing to invest at the scale needed to achieve the goals of climate smart agriculture and food security.**

## 2. Key Messages

The key messages are the following:

- 1. A number of countries are making great progress in integrating the agriculture, food security and climate change agendas but many challenges remain.** Raising agricultural productivity is needed to both offset the climate change yield losses that are projected in many developing countries, as well as meeting growing demand for food -- a double challenge. Better managing weather risk, diversifying household income, and improving market linkages to better match surplus and deficit regions will all be increasingly important to maintain agriculture as a viable and profitable economic base for life in the countryside.
  - A global food producer for which agriculture and land use change account for over 70 percent of greenhouse gas emissions, Brazil's priority is to reduce emissions while maintaining competitiveness, by supporting "climate-smart" measures in the crop and livestock sectors and sharply reducing deforestation in the Amazon by 80 percent by the year 2015. Brazil's experience is increasingly being shared with other tropical countries. *A lesson from Brazil is that the pattern of public support, investing in*

*research and support measures which are adapted to tropical soils and restore rather than mine them, as opposed to providing commodity subsidies, is highly effective in increasing productivity in a “climate responsible” way. Brazil has provided the enabling environment for private farmers to take advantage of the “triple win” of increasing productivity, increasing resilience, and reducing emissions from the agricultural sector.*

- As a large, diverse, densely populated country largely comprising very small farms, Mexico and China are meeting their food security and climate smart development objectives through a mix of measures. China has had a long term program of watershed and agricultural landscape restoration and is now a net carbon “sequesterer” from land use changes. Its focus is on supporting technologies to increase intensification, improving the productivity of agricultural water management and managing its livestock sector to enhance soil fertility and rural energy access. Mexico’s agricultural and water sector programs both focus on adaptation, with public support for a number of measures to increase resilience. There is support also for improved animal waste management, forest fire management and reforestation. *A lesson from China and Mexico is that in land and water scarce countries, more efficient natural resource management approaches will enhance resilience and promote low carbon growth.*

2. **Water management is an increasingly critical challenge in water stressed countries;** water conservation, “more crop per drop,” are priorities. Countries such as Uzbekistan can do much to improve irrigation and drainage efficiencies. In Morocco private farmers are making great progress with water conservation technologies in high value irrigated agriculture, but broader support to social protection and broader socio-economic development measures as well as to sustainable land management is the priority in the rainfed areas. In Yemen also broader socio-economic diversification and food security measures combined with support to water harvesting are key, together with policies that encourage water conservation. *A lesson from these countries is that improved water management measures need to be combined with broader support for economic diversification.*
3. **Successful programs need a long term commitment and strong local ownership, through bottom-up approaches that are adapted to local circumstances.** This approach has been successful even in highly challenging environments. The Arid Lands Program in Kenya and the Community Action program in Niger have both taken this approach, building on local social capital. *A lesson is that these programs need to be adapted to local circumstances and implemented to scale to have real impact. They also need to be combined with social protection and food security measures as well as support or access to basic services.*
4. **Patterns of public support which focus on research, investments in soil and water conservation, land tenure, technology and value chain development rather than price support are more effective, benefit more farmers and are more sustainable in the long run.** In Uzbekistan, land privatization together with some liberalization has enabled a doubling of wheat yields, for example. Adaptive research was key to Brazil’s agricultural productivity increase. And China’s investments in watershed management

have enabled impressive productivity increases. *A key lesson is that the quality of public expenditure is as important as the quantity in facilitating private farmer investment in climate-smart agriculture.*

5. **In the countries most highly exposed to climate variability and change, disaster management and a climate resilient, diverse agricultural sector are closely linked.** For Bangladesh flood and cyclone management is key to food security and climate resilience but agricultural diversification and technology development are also major development pillars. For Albania watershed management goes hand in hand with agricultural innovation and enhanced value added on the more fertile lands.
6. **Integrated landscape-based approaches, including agriculture, pasture, livestock, forestry, and fisheries are the key for success, especially in adaptation to climate change.** These approaches need to be combined with measures to enhance productivity, sustainable intensification, value added and commercialization. Thus, programs need to overcome narrow “silo” approaches. There are lessons to be learnt from China, Albania, Kenya, and Mexico in this regard.
7. **A conducive legal, institutional and policy enabling environment is important.** Frameworks which are transparent, adapted to country capacities and which can realistically be enforced are key, while land tenure, access and rights to land are also important. Clarity on land rights facilitated large-scale landscape restoration in the Loess Plateau in China, and reforestation and drastic reductions in illegal logging in Albania.
8. **The new funds for food security and climate smart agriculture will be most effective if blended with ongoing support programs and there is scope for focusing more on synergies between the two agendas.** Niger is both a PPCR (Pilot Program for Climate Resilience) and GFRP (Global emergency Food Response Program) country for example, and Haiti, Yemen and Bangladesh are all PPCR and GAFSP (Global Agriculture and Food Security Program) countries. Carbon finance has worked well when combined with other development finance (e.g. fuel wood plantations as part of the Community Action Program in Niger, carbon finance to off-set part of the costs of biogas development in China). *There is much scope for greater synergy among different sectors both within countries and within development institutions.*
9. **Carbon finance has supplemented other finance so far to a limited extent, and mostly in middle income countries. Lower income countries need faster access, and inclusion of soil carbon in addition to REDD and reduced emissions from livestock is a priority.**

### 3. Country Summaries

**Mexico: an Agricultural Sector program which addresses climate change as a major challenge, with a focus on adaptation.** Agriculture accounts for 4 percent of GDP but 15 percent of employment and agricultural landscapes play a key role in watershed protection and broader ecosystems conservation, and include highly varied production systems. 23 percent of cropland is irrigated and the sector accounts for 77 percent of water use. Agriculture and land use changes together account for about 21 percent of GHG emissions. 23 percent of land area is forested but deforestation has played a major role in GHG emissions over the last 20 years. Mexico is expected to experience increasing temperatures, reduced rainfall and increased incidence of extreme weather events over the coming decades, including increased incidence of forest fires and reductions in agricultural productivity.

Mexico's 2007-2012 Agricultural Sector and Water Program both focus on climate adaptation; they include support measures for crop rotation and fertilizer management, targeted research, seed reserves, conservation tillage, extreme weather events, wild land conservation, improved agricultural water management, flood and integrated water managements. Related mitigation support includes promotion of zero tillage, reduced use of fire, reforestation, methane capture from livestock and more efficient use of energy in fisheries. Mexico has 23 CDM projects related to agriculture all addressing animal waste management. It also has its own Mexico Carbon Program.

The World Bank is supporting Mexico's program through a series of Development Policy Loans, including one on Adaptation to Climate Change in the Water Sector, and through a Sustainable Rural development project which also addresses agri-businesses, and community based rural development/natural resource management operations. Mexico is also participating in the FIP (Forest Investment Program).

**Uruguay: a major livestock exporter vulnerable to climate change impacts which is taking measures to promote climate smart agriculture through a range of sustainable land management approaches:** Uruguay is a major regional exporter of agricultural and livestock products, which accounts for about 9 percent of GDP and 25 percent of exports (though only 4 percent of employment). Pasture-land accounts for 77 percent of Uruguay's land area, with a further 8 percent each for forestry and arable lands. Temperature, precipitation and incidence of extreme climate events are all projected to increase, with a negative effect on land productivity. Agriculture and land-use change accounts for over 50 percent of GHG emissions, of which methane from farm animals constitutes the great majority. Uruguay is responding by: improving pasture-land and hence animal nutrition, supporting reduced tillage practices on crop-land together with improved crop breeding, and promoting afforestation, shelter and protection of native forests. Uruguay also has a number of subsidized climate-related crop insurance schemes in place. This combination of measures to support resilience and reduced emissions is already contributing to reduced CO<sub>2</sub> and CH<sub>4</sub>. Despite Uruguay's relatively strong capacity and highly developed information base, it does not yet have any registered CDM (clean development mechanism) projects in agriculture, including afforestation or reforestation.



**Brazil: a diverse country and a food producer for the global market where improved land management is a key element in climate resilient, low carbon, environmentally sustainable and competitive growth:** Brazil has highly diverse and favorable growing conditions for a range of commodities; agriculture accounts for only 7 percent of GDP but in 2009 it accounted for nearly 40 percent of the world's soybean and chicken exports and Brazil is a global food producer. 57 percent of the land area is forested and 24 percent is pasture land. Deforestation and land use changes associated with expansion of agriculture and livestock account for over 70 percent of GHG emissions in Brazil, which is the globally fifth largest GHG emitting country. Expected climate change impacts vary regionally, with increased water stress expected in the already drought-prone north-east and reductions in the areas suitable for cultivation of a number of key crops, including and especially soybean and coffee.

The country has adopted a regionally adapted approach to development working largely through decentralized structures. It has invested heavily in research in crops and farming systems adapted to its soils and climate, focusing policy support on these measures. A substantial part of its research has focused on the less fragile, low fertility Cerrados areas, thereby reducing pressure on the more vulnerable Amazon forests. It is committed to reducing deforestation in the Amazon by 80 percent by 2015, and is supporting a suite of policy measures to support the agricultural sector to enhance land and water management and enhance carbon sequestration in the agricultural landscape, while adopting improved technologies, business practices and marketing chain approaches. Specific examples include rural competitiveness programs in Santa Catarina, Sao Paulo and Rio states. Biofuels are also part of a low carbon growth approach. Brazil has a favorable climate for these and supports measures which focus their development largely in areas of abandoned pasture-land.

Brazil's approaches are articulated in key policy documents such as the environment agenda within the National Plan (PPA), the Sustainable Amazon Plan (PAS) and the National Water Resources Plan, which aim to address environmental sustainability and climate change at the inter-sectoral level and within targeted sectors such as agricultural lands, forests, water and energy. These programs have been supported by the Bank through development policy lending. Improved irrigation and drought management form part of the resilience program and Brazil also has targeted social protection programs and agricultural insurance programs. Brazil is participating in one of the new climate investment funds, the FIP (Forest Investment Program) and in carbon trading through CDM in agriculture, for projects related to improved animal waste management and biomass electricity generation. It currently has no registered projects in afforestation or reforestation.

Brazil is now sharing its experience with other countries, including in Sub-Saharan Africa.

**Niger: Food Security, enhanced agricultural productivity and Climate Resilience are converging challenges in one of the world's most vulnerable countries:** Niger is a Sahelian country with highly variable rainfall and 84 percent of the population dependent on land based activities including cropped agriculture and livestock rearing for survival. Agriculture accounts for 39 percent of GDP and the great majority of GHG emissions. However only 3

percent of the rural population has access to electricity and overall GHG emissions are very low. With very poor human development indicators, 50 percent of its population suffers periodically from food insecurity, and the 2009-2010 drought has exposed some areas to famine. Temperatures are projected to increase and the incidence of extreme weather events to become more frequent over the next decades. The 2008-2012 Poverty and Economic Growth strategy recognizes the key role of agriculture and the impact of climate on development and human welfare.

The government is addressing these challenges through a strategy which combines support for increased intensification on the most productive lands, commercialization of both crops and livestock products, improved land and water management to address soil fertility, erosion and run-off issues, and a social safety net program. Government also recognizes the key role of addressing core development issues of health, education and access to basic services. *Niger's Community Action plan* is key to these agendas. It supports local capacity building to deliver development at commune level, and includes social protection, local infrastructure, pilot soil conservation and afforestation measures. This approach is providing the institutional base for funding through both the *PPCR* (Pilot Program for Climate Resilience), and the *GFRP* (Global Food Crisis Response Program), in addition to substantial ongoing development partner and budget financing, and *Biocarbon fund* and *GEF* support. (The *PPCR* will likely support social protection and enhanced land management). *Irrigation programs* are also being scaled up and adapted with African Development bank and *PPCR* funding, and the ongoing *Agro-Silvo-Pastoral Exports and Markets* will help develop improved risk management mechanisms and develop marketing chains. The need for *timely information on weather and climate* in a form that is accessible to local people would be addressed through a Regional Climate program supported by the AfDB. In Niger there are opportunities for “climate smart” agricultural development, but for Niger to move towards climate resilience these programs need to be sustained over time, supplemented by effective emergency response measures and combined with broad economic diversification and socio-economic development support.

**Kenya: climate-smart development in a challenging environment:** Kenya has one of the most diverse economies in Africa, with substantial foreign exchange earnings from agriculture and tourism, both heavily dependent on the natural environment. Agriculture contributes 27 percent of GDP but 75 percent of employment; 78 percent of people live in rural areas. Geographically diverse, the north and east are arid and semi-arid while the central highlands have fertile soils and good rainfall. Kenya faces increasingly severe and frequent floods and droughts, exacerbated by land degradation. Yet it has developed regionally adapted approaches to addressing climate risks and creating an enabling environment for private sector development in diverse areas, including commodities such as tea and coffee, high value fruits and vegetables, and livestock.

Kenya's Agricultural Strategy, launched in 2010, has the vision of a “food-secure and prosperous nation”, and includes pillars and policy measures to enhance productivity, support irrigation, diversification, food security, research, access to inputs, improved seeds, targeted and time-bound subsidies to the poorest, private sector investment, environmental sustainability and adaptation and mitigation including early warning systems. It aims to achieve an agricultural growth rate of 7 percent per year. The program has been developed within the CAADP (Comprehensive African Agriculture Development Program) framework.

Concerning specific programs, The *Arid Lands Program*, is continuing to support agro-pastoralists in the north and north-east manage risk through a mix of community driven technical and social interventions, including innovative early warning systems and drought contingency funds. In Western and South-western Kenya *community flood management, watershed management and natural resources programs* all aim to improve landscape management, productivity and resiliency with strong community participation. With the help of the Biocarbon Fund Kenya is piloting *soil carbon sequestration based on the adoption of sustainable agricultural land management practices through which smallholder farmers can receive additional payments* as well as in reforestation through the Kenya Green Belt Movement project. Thus, these projects capitalize on the synergies between soil carbon, productivity, and climate resilience. Kenya has highly productive fertile soils in the central highlands which are producing a range of crops for the local and export market. The *Agricultural Productivity and Agribusiness program* supports private smallholders in technology enhancement and agribusiness and market development, and sustainable land management, building on existing gains in extension, research and small farmer empowerment.

**Yemen: The challenge of balancing food security, the need for short term cash returns and “climate smart” agriculture in a water stressed environment:** Agriculture comprises 15 percent of GDP and over half of employment, though only 7 percent of the land area is cultivable. 32 percent of the population is estimated to be food insecure, and more than 90 percent of households are net food buyers; although cereals account for 54 percent of cultivated area Yemen produces less than 20 percent of the wheat it consumes. Agriculture and forestry contribute 27 percent of GHG emissions. Yemen is expected to experience increasing temperatures and increasing variability in rainfall and hence incidence of both floods and droughts over the coming decades. Yemen is highly water stressed: renewable water resources are estimated at 1.5 billion m<sup>3</sup> per year and annual withdrawals at nearly 2.5 billion m<sup>3</sup>. Irrigated agriculture accounts for 90 percent of withdrawals; groundwater resources are depleting especially rapidly, at 2 ½ times the rate of replenishment. Qat, a mild stimulant is the main cash crop, and accounts for 40 percent of water withdrawals; the area planted to it has tripled over the last 25 years. Yet analyses have indicated that increasing fuel prices (to increase the cost of groundwater pumping and reduce over-pumping) would likely increase poverty and reduce agricultural incomes in the short to medium term Fisheries are an important sector and the second export after oil.

Yemen’s agricultural and rural strategy aims at food security, with broad economic diversification and improvements in efficiency in agriculture and fisheries; climate risks are being incorporated into the 2010-2015 National Development Plan. A number of programs are ongoing to improve land and water management, including a groundwater and soil conservation program and a new Water Sector Support Project, as well as a program for rainfed agriculture and livestock and an accompanying GEF-supported agro-biodiversity and climate adaptation project. Yemen is participating in both the GAFSP (Global agriculture and food security program) and the PPCR (Pilot program for climate resilience). A broad agriculture and economic diversification approach, combined with targeting of social transfers and health and nutrition awareness, will be necessary as Yemen gradually moves towards managing its land and water more sustainably and faces increasing climate challenges.

**Morocco: adapting to increasing water stresses while addressing social challenges and modernizing the sector:** Agriculture accounts for 15 percent of GDP but 50 percent of employment and about 20 percent of exports, very largely from irrigated horticultural products. Irrigated land accounts for about 15 percent of cropped area but over 50 percent of the value of production, and irrigation accounts for over 85 percent of water use. The rain-fed sector is dominated by low yielding cereal production which is highly vulnerable to fluctuations in rainfall, grown by small-holders, many of whom are aging. Morocco currently imports 50 percent of its cereal needs. Morocco is predicted to become drier and hotter, placing increasing stresses on both rainfed and irrigated production. Agriculture accounts for about 27 percent of GHG emissions mostly from soil degradation.

Morocco's 2008 agricultural strategy (Plan Maroc Vert(PMV) envisages a major sector overhaul in terms of cropping patterns, land tenure and taxation, including international trade liberalization, with two major pillars: support to rapid growth and competitiveness of private farmers in the modern, irrigated sector, and rural poverty reduction measures in the rainfed sector. Increased agricultural water productivity is major theme in this strategy and key to sector resilience. The World Bank is supporting the *PMV through development policy lending*, and with GEF support is addressing knowledge gaps and pilot adaptation measures; it is also supporting improved irrigation management through the *Modernization of Irrigated agriculture in the Oum Er Rbia basin program*.

There is potential for a greater focus on resilience in the PMV, and there is potential for reducing emissions and increasing carbon storage.

**China: towards low carbon, climate resilient agriculture, land and water management while increasing productivity and intensification:** China is increasingly facing up to the challenge of managing its resources sustainably in a changing climate, while meeting objectives of food security and poverty reduction. Agriculture contributes about 13 percent of GDP and includes about 250 million farm families, mostly with small-holdings of 1 hectare or less. China is projected to suffer from increasing water stress and rising temperatures in several regions. The agricultural sector accounts for 15 percent of GHG emissions mostly from the livestock sector and from paddy rice, and has become the largest source of water contamination. Addressing the environmental footprint of agriculture is a major challenge for China.

China's priorities for agriculture cover continued modernization through market development, technical innovation, intensification, food safety, regional development, improved land tenure security, disaster management and climate resilient low-carbon agriculture. The strategy involves moving away from quantitative targets to more balanced production while maintain the objective of food security.

Regarding climate risks, China's priority is to strengthen the resilience and reduce the emissions of the agricultural sector through technology enhancement, rural energy and land and water management. It has made progress in this regard in key national grain production areas (such as changing cropping patterns, irrigation and water saving technologies and

support for more resilient varieties), in water stressed regions, in coastal regions and in ecologically fragile areas. China, thanks to its longstanding reforestation and watershed management programs, is now a net “sequesterer” of carbon from land use and forestry. Its Loess Plateau program restored degraded landscapes while increasing productivity. Its reforestation programs have helped stem watershed erosion and now include a greater diversity of species, and more effective community management.

Programs supported by the Bank include the innovative *Irrigated Agriculture Intensification Project (IAIL3)* which seeks to improve productivity of agricultural water management, and the *Agricultural technology and Jilin food safety project*, which supports value chain development and risk management, as well as a movement away from government being a direct actor to being service provider. China has a number of operations addressing agricultural pollution prevention and climate mitigation, including Biogas projects some of which have CDM support, and the Henan Yellow River Ecological livestock project. The earlier Coastal Zone Management project established pollution monitoring systems and fisheries resource management.

A new Comprehensive Agricultural Development project is under preparation which would cover key grain provinces and invest in improved land and water productivity, crop yields, fertilizer management and rural energy efficiency and would scale up further the lessons learned in resilience and mitigation. The experience in China demonstrates the synergies between “climate smart,” broader environmentally sustainable agriculture and sector modernization and food security.

**Bangladesh: meeting food security goals in a densely populated country highly vulnerable to natural disasters** With a population of 160 million, per capita GDP of US\$ 470, arable land of only 8 million hectares, and with agriculture accounting for 63 percent of employment and 20 percent of GDP, Bangladesh has one of the highest “man-land” ratios in the world. A highly productive agricultural sector is thus key to food security. As a low lying downstream riparian country (70 percent of land area is 5 m or less above sea level) Bangladesh is also one of the countries most exposed to extreme climate events and to the impact of climate change, from both flooding and sea-water intrusion. 20-30 percent of the land area is flooded annually. Enhancing resilience is a major challenge not only for agriculture but for the substantial non-farm rural economy.

Bangladesh’ agricultural strategy includes measures for technological innovation, diversification from rice into higher value livestock, fisheries and horticulture, and land and water management. Disaster management forms a key part of its strategy, with 6 million ha of agricultural land under some form of protection, a large program of coastal protection including structural and non-structural measures, flood warning systems and elevated ‘safe havens’ in many areas. A major challenge is to manage water sustainably.

Ongoing programs include a *National Water Management Improvement Program*, which is introducing a more integrated approach to flood management, and protection drainage and irrigation, restoring natural regimes where appropriate. A *National Agricultural Technology Program* is supporting innovation, crop diversification and demand driven extension and value-chain development. And *Emergency cyclone recovery and restoration program* would

support enhanced crop, livestock and fisheries productivity in cyclone affected areas. A *Social Investment Empowerment program* supports broader livelihood and risk reduction measures. Bangladesh is participating in the *GFRP and PPCR* and is preparing a *GAFSP proposal*.

For Bangladesh disaster management, food security, social protection and climate resilience go together, accompanied by broader programs for socio-economic development and diversification.

**Uzbekistan: Improving resilience for a sector largely dependent on irrigation in a downstream country facing an increasingly water stressed environment.** Agriculture accounts for 23 percent of GDP, 34 percent of employment and 40 percent of exports and sector growth is robust. Livestock accounts of 40 percent of agricultural GDP. As a downstream country in an arid environment, 85 percent of cropped area is irrigated. Cotton plays a key role in the agricultural economy and Uzbekistan is the world's second largest exporter of this commodity. Uzbekistan is likely to experience increasing temperatures and some increase in summer precipitation, but substantial decline in water flows from its two major rivers is expected together with increasing evapo-transpiration. The cropped sector is likely to suffer from water stress and the livestock sector from heat stress. The agricultural sector contributes only 12 percent of GHG emissions net; declines in swamp rice cultivation have reduced its contribution.

For decades Uzbekistan irrigation water consumption has exceeded natural river flows, contributing to the desiccation of the Aral Sea. It has not used irrigation water efficiently, and high use levels together with poor drainage have contributed to salinity problems and further exacerbated the drying of the Aral Sea. Uzbekistan has identified a number of adaptation options for agriculture, including improved weather and climate monitoring, development of new adapted varieties, improved agronomic practices including minimum tillage, increased water efficiencies and catchment management involving all stakeholders, improved pasture and fodder and development of new livestock breeds. It is in the early stages of integrating these options into agricultural policies and practices at a farm level and of moving from a "top down" support delivery system to one that is demand driven and pluralistic. Its agricultural strategy objectives concern the maintenance of export revenues, food security and improvements in rural living standards. Uzbekistan has moved with land reform, creating an enabling environment for private farmer investment in land productivity.

There are ongoing programs in *improved irrigation and drainage* management and wetland rehabilitation, especially near the mouth of the Amu Darya river, to improve water management in the fertile *Ferghana Valley*, and to encourage *farm productivity and agri-business development including improving the enabling environment for access to finance*. These programs will improve resilience, especially if combined with further measures to liberalize the agricultural economy.

**Albania: Managing agriculture in a mountainous country highly exposed to climate risks and change.** Agriculture accounts for 21 percent of GDP but 58 percent of employment and 20 percent of exports. 56 percent of agricultural value added is from livestock, much of it raised in the highlands. The flatter coastal areas are dominated by crop production, with most

value added from vegetables, and the mountainous areas by forestry and pasture. South eastern Europe is one of the region's most affected by climate change; Albania is already highly vulnerable to floods and droughts, and over the next 40 years mean temperatures are predicted to increase by 2 degrees C and precipitation to decline by 8 percent. Rainfed areas will be relatively more vulnerable than the irrigated land on the plains. 46 percent of GHG emissions come from agriculture, land use change and forestry.

Albania's Inter-Sectoral Rural Development strategy (2007-2013) prioritizes enhancing competitiveness through strengthening agro-food chains and higher value added production. A recently closed agricultural services project has supported these initiatives. Albania's forests and pastures play a key role in landscape and watershed conservation as well as in provision of fodder and fuel, and there has been a successful community based reforestation and pasture management which has also benefited from carbon finance through the Biocarbon fund. Land reform has supported development of a clear land rights system, and this has facilitated private investment in land productivity and in pasture and forest restoration. The recent water resources project has focused on dam safety, irrigation and drainage restoration and river bed restoration to help reduce vulnerability to climate risks. And a grant for disaster preparedness is strengthening institutional capacities in this area.

Albania's "climate smart" agricultural strategy will focus on increasing resilience (in upper as well as lower watersheds) and on increasing intensification and value added for higher value livestock and horticultural products. The EU accession process also provides opportunities in these areas.

#### **4. Challenges and the Potential of Policy Support Measures**

The preceding paragraphs have summarized the approach of a number of countries in introducing policies and accompanying support measures to move towards "climate-smart" agriculture.

There are challenges in adapting new approaches to different parts of countries, in facilitating cross-country learning, south-south as well as north-south, and continuing innovation, and in mainstreaming "climate-friendly" approaches into broader policy support measures at local as well as national level. There are challenges also in overcoming initial barriers, including broader barriers such as land rights and lack of infrastructure or favorable trade regimes to access new markets. Land rights are a particularly difficult and sensitive issue in some countries, sometimes with overlapping "traditional" and "modern" systems and many competing interests. There are also trade-offs between the short term costs and longer term productivity gains, or spatial trade-offs between investments in ecosystems upstream in a watershed bringing services downstream for a different area, sector or group of people. Overcoming these barriers requires the right mix of policy instruments to encourage long-term adoption. These are discussed in more detail in companion papers, but the country examples also show how the pattern of support can influence climate-smart agriculture. Clear, simple legal, fiscal and institutional frameworks which are adapted to country circumstances, have widespread support, are understood by citizens and are easy to enforce, are also important; often these frameworks are too complex and not easy to enforce.

**More broadly, the agricultural sector has traditionally been underfunded in developing countries.** While agriculture represents on average 29 percent of GDP in agriculture-based economies, public spending on agriculture accounts for only 4 percent of agricultural GDP, according to the World Development Report 2008. The corresponding figures are 16 percent and 11 percent for transforming economies and 10 percent and 12 percent for urbanized economies. Furthermore, often the quality of spending the allocated amount is low.

On the contrary, OECD agricultural subsidies are worth more than US\$ 260 billion per year, and have traditionally been targeted at supporting intensive production through price supports and a variety of other protection measures. However, of this support, only 2 percent is for non-commodity services or for environmental services (such as creating buffer strips to protect waterways). By removing the current levels of protection, it is estimated that industrial countries could induce annual welfare gains for developing countries of over five times the current flow of aid to agriculture, although the impacts would differ among countries.

There is a great opportunity, in both developed and developing countries, to re-orient support programs away from distorting policies which support neither efficiency nor environmental sustainability, to measures which do not distort private farmer production patterns but which enhance key “underlying drivers” of sustainability and competitiveness, such as support for improved soil and water management, infrastructure, energy and communications to improve market access, research and knowledge.

**The European Union has already modified its Common Agricultural Policy so that income support to farmers is contingent on their meeting good environmental and agricultural standards.** The second pillar of its agricultural policy goes to broad measures to improve competitiveness, manage the environment and the land and increase diversification. Specific agri-environment measures also provide support for sustainable land management and landscape restoration. These measures are similar to those summarized in the programs mentioned above in the Brazil, China and Kenya examples, though adapted to different socio-economic and climatic conditions. More broadly, there is great scope to create the policy environment for investing more in watershed and landscape restoration, measures which conserve longer term productivity and resilience, while also sequestering above and below ground carbon, thereby reducing emissions.

**The Agri-Environment Programmes of the EU Common Agricultural Policy:** These schemes are designed to encourage farmers protect and enhance the environment by providing payments to those who subscribe, on a voluntary basis, to environmental commitments related to the preservation of the environment and maintaining the countryside.

Farmers commit themselves, for a minimum period of at least five years, to adopt environmentally-friendly agricultural techniques or levels of production that go beyond legal obligations. In return, farmers receive payments that provide compensation for additional costs and income foregone resulting from applying those environmentally friendly farming practices in line with the stipulations of agri-environment contracts.

Agri-environment measures may be designed at the national, regional, or local level so that they can be adapted to particular farming systems and specific environmental conditions. This makes agri-environment a targeted tool for achieving environmentally sustainable goals. Agri-



environment measures are co-financed by Member States. EU expenditure on agri-environment measures amounts to nearly 20 billion EUR or 22 percent of the expenditure for rural development, for 2007 - 2013.

Within Africa the CAADP (Comprehensive African Agricultural Development Program) is a framework for accelerated agricultural development that has been adopted by African Union at the Heads of State level. The primary CAADP goal is agriculture led development that eliminates hunger, reduces poverty and food insecurity, opening the way for export expansion. CAADP, which seeks to attain agricultural growth rates of 6 percent per year through 2015, comprises four pillars:

- Extending the area under **sustainable land management** and reliable water control systems;
- **Improving rural infrastructure** and trade related capacities for market accesses;
- Increasing **food supply**, reduce hunger, and improve responses to food emergencies
- Improving **agriculture research**, technology dissemination and adoption

There are cross cutting themes on knowledge and capacity building. CAADP does not explicitly address climate vulnerabilities. However the recent Conference in Addis Ababa made a call for climate to be integrated within the CAADP pillars, and there is much to build on from the Terrafrica platform for sustainable land and water management, supported by NEPAD (the New Partnership for Africa's Development) within the CAADP framework.

**Many countries have under-invested in the key “public good” of weather and climate information.** There is growing recognition of the importance of having such information available and easily accessible to a range of different users, including farmers and herders, foresters and fishermen; but there are important gaps in the collection, analysis and dissemination of basic hydro-meteorological monitoring parameters in many countries. There are also opportunities for greater sharing of information between countries.

There are also broader policy measures which could be used to support efficiency and environmental sustainability in production systems. Carbon taxes, if applied to both energy and land-use change, would provide strong incentives for increased intensification of crop production on a more limited land area, and would provide incentives also for protection of forests and grasslands. However, a carbon tax applied only to fossil fuel only, could provide an incentive for an increase in the clearing of forests and agricultural land for biofuels, as opposed to pasture or forest conservation. Other alternatives being considered are ‘cap and trade’ approaches.

## **5. Mobilizing Finance for a Transformational Change to Climate-Smart Agriculture**

**Work by a number of expert groups highlighting the key role that agriculture plays in growth and poverty reduction** has helped to bring renewed focus to agriculture and related natural resource management over the last four years. The 2008 World Development Report on Agriculture, and the 2008 food price crisis, provided further impetus. World Bank group commitments have increased substantially since the early years of the decade from a “low” of less than US\$ 2.5 billion in the 2001-2005 period. They averaged US\$ 4.1 billion annually in

the 2006-2008 period, of which US\$ 1.2 billion from IFC and US\$ 2.9 billion from IBRD/IDA. They increased again sharply in FY 2009 to US\$ 7.3 billion partly as a result of the 2008 food price crisis. However there were reductions in FY 2009, related in part to competing demands for IBRD/IDA resources due to the financial crisis, with overall commitments at US\$ 6.1 billion, of which US\$ 4.1 billion is from IDA/IFC.<sup>1</sup>

**The traditional multi-lateral development banks and other multilateral and bilateral development partners are scaling up support to investments in agricultural productivity.**

The UN system including the World Food Program and the Food and Agriculture Organization, and the World Bank are key partners in this regard. The Arab Funds, concerned with food security in their own countries, as well as addressing poverty reduction and growth in poorer countries, are increasingly investing in this area. A number of charitable foundations also provide support to investments in increasing agricultural productivity, livelihoods and enhancement of environmental sustainability. And private sector investment in agriculture is highly diverse and growing in a range of areas, from highly intensive horticultural production to large-scale bio-fuel and commodity production.

**There are a number of emerging funds aimed at tackling climate resilience, low carbon growth or food security issues; the challenges is to use these together with existing sources of private and public sector finance to achieve the goal of “climate-smart agriculture” integrating the objectives of agricultural productivity, food security and climate change.** Some of these major programs are summarized below. They include the Climate Investment Funds, a series of funds specifically focused on climate change mitigation and adaptation, but often with a multi-sectoral perspective. Then there are also the Global Agriculture and Food Security Program (GAFSP) and the Global Food Price Crisis Response Program (GFRP), more specifically focused on agricultural issues. These are in addition to the Global Environment Facility, which includes windows to address climate change, land degradation and biodiversity, a number of pilot funds developed through the Carbon Finance Facility and the emerging funds to address REDD (reduced emissions from deforestation and forest degradation).. There are also a number of markets established through the Clean Development Mechanism (for carbon emissions trading) which are not discussed here.

**The Global Agriculture and Food Security Program (GAFSP)** is a multilateral financing mechanism (US \$900 million mobilized), which will allow the immediate targeting and delivery of additional funding to public and private entities to support national and regional strategic plans and scale-up assistance for agriculture and food security, on a coordinated basis, in poor countries. The plans are designed and implemented by developing country governments and their regional partners.

Channeling multiple sources of donor financing through a common mechanism can reduce fragmentation and recipient country transaction costs of aid, and improve alignment around country programs. Existing bilateral and multilateral funding cycles typically require several years advance programming by countries, are not easily amenable to restructuring of already allocated resources, and coordinating donor replenishment cycles is difficult.

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<sup>1</sup> The following paragraphs summarize some of the more recently established food security and climate-related funds. The list is not intended to be comprehensive; it focuses largely on funds where the multi-lateral development banks are more closely engaged.

Depending on country and regional requests, GAFSP financing is aimed to provide for:

- **raising agricultural productivity** by supporting: a) adoption of high-yielding technologies; b) technology generation; c) water management; and d) land rights;
- **linking farmers to markets** by supporting: a) reduction in transaction costs; b) value addition; and c) mobilization of rural finance;
- **reducing risk and vulnerability** by supporting: a) price and weather risk management; b) strengthening food-related social protection for people who face chronic and transitory rural poverty; and c) improving nutrition of mothers and young children;
- **non-farm rural livelihoods** by supporting: a) investment climate improvements; and b) entrepreneurship promotion.
- **technical assistance, institution-building and capacity-building** by supporting: a) sector strategy development, investments and implementation; b) enhancing design, monitoring and evaluation; and c) knowledge development and dissemination.

Through these action, expected impacts would be in improved incomes and **food security** of poor people in developing countries through more and better coordinated public and private sector investment in the agriculture and rural sectors that is country-owned and led; more predictable aid flows for countries by addressing repeated and large existing financing gaps in ongoing bilateral and multilateral assistance; and increased effectiveness of aid in agriculture and food security. So far, grants totaling US\$ 224 million have been approved for Sierra Leone, Togo, and Rwanda to address these critical issues. Grants are under preparation for Bangladesh, Yemen and Haiti.

The GASFP framework document states that “GAFSP does not have a separate component on climate change adaptation and mitigation. Climate change cuts across all components of GAFSP. Raising agricultural productivity is needed to both offset the climate change yield losses that are projected in many developing countries, as well as meeting growing demand for food -- a double challenge. Better managing weather risk, diversifying household income, and improving market linkages to better match surplus and deficit regions will all be increasingly important. The components of GAFSP cover these aspects, as areas for increased investments. The intention is to not duplicate investments through specific climate investment funds”. The document thus provides an enabling environment for complementary funding from other sources including the climate investment funds and REDD.

**The Global Food Crisis Response Program (GFRP)** includes a facility encompassing several funding sources, with an authorized ceiling of \$1.2 billion. Its objectives are to:

- Reduce the negative impact of high and volatile food prices on the lives of the poor in a timely manner
- Support governments in the design of sustainable policies that mitigate the adverse impacts of high and volatile food prices on poverty
- Support broad-based growth in productivity and market participation in agriculture to ensure an adequate supply response as part of a sustained improvement in food supply
- Thus, interventions need to be rapid, include the poor and disadvantaged, and contribute to achieving sustainable longer-run **food security**. The program finances a mix of stand-alone technical assistance, development policy and investment operations, drawing upon country and international experience under four components:
  - **food price policy and market stabilization;**

- **social protection actions** to ensure food access and minimize the nutritional impact of the crisis on the poor and vulnerable;
- **enhancing domestic food production** and marketing response; and
- **implementation support**, communications and monitoring and evaluation.

The program contributes to a reduction in the stress on environmental and social systems that arise from food shortages and lack of access to food (and that force many societal groups, including the most vulnerable, to degrade ecosystems of their supplies) due to its potentially wide range of efforts to improve access to and the availability of food in communities most at risk due to high food prices. So far over US\$ 1.1 billion has been committed to 35 countries. Niger is likely to be the most recent recipient, following the 2010 drought.

**The Climate Investments Funds (total US\$ 6.3 billion)** have been established to help developing countries move towards lower carbon growth paths on the one hand, and to integrate climate resilience in broader development programs on the other. Programs financed through these funds are designed and implemented by countries, with the assistance of Regional Development Banks, the IFC and the World Bank. Each has a separate governing body composed equally of members from developing and developed countries, and with observers from the private sector and civil society organizations. The aim to integrate finance provided by the CIFs into programs already under way or preparation, scaling up and bringing a resilience element to them.

The largest of these is the ***Clean Technology Fund (US\$ 4.4 billion)***. Programs for US\$ 4.4 billion have been approved for thirteen countries, mostly middle income and large emitters. Despite the importance of agriculture and land use change in GHG emissions (over 30 percent), however none of the CTF programs has included measures addressing agricultural emissions; the focus of all has been on energy efficiency, renewable energy and urban transport. However all have successfully blended CTF with other forms of finance, and the total value of CTF programs is over US\$ 25 billion.

The second largest is the ***Pilot Program for Climate Resilience (US\$ 967 million)***, which aims to help countries transform to a climate resilient development path, consistent with poverty reduction and sustainable development goals. Thus adaptation is the key focus. Nine countries and two sub-regions (Bolivia, Yemen, Tajikistan, Niger, Zambia, Mozambique, Nepal, Bangladesh, Cambodia, the Caribbean and the South Pacific) have been selected, and all are in the process of developing strategic programs for climate resilience, which will include investment, capacity development and knowledge sharing elements. All of the programs currently under preparation include agriculture, forests or water management as priorities (together with enhanced access to climate information, disaster management, coastal zone management in areas vulnerable to storms and sea-surge, and an improved approach to design and maintenance of infrastructure). The Strategic Programs for Climate Resilience furthermore aim to blend funding from the PPCR with other development funding in order to take advantage of existing programs' implementation capacity and scale up existing or bring new climate resilience dimensions to these programs. For example in Niger the PPCR is likely to support improving the accessibility and timeliness of weather information to farmers; irrigation, social protection, and land and water management as well as risk management tools. Especially in countries dominated by agriculture it makes sense to blend development and public finance with the new climate and food security funds.

*The Forest Investment Program (FIP) has a financing envelope of US\$ 550 million* approved for eight countries (Mexico, Brazil, Peru, Ghana, Burkina, DR Congo, Nepal, Laos and Indonesia). FIP aims to help countries develop and finance programs which reduce emissions from deforestation and forest degradation, and helps them also put in place sound monitoring and measurement schemes. Transparency and improved governance, environmental and social sustainability and local participation are key elements. The FIP recognizes that agriculture, much of it “extensive” slash and burn agriculture by poor communities needing food, fuel and fodder for livestock, is a major driver of deforestation and degradation. Investment Programs will include measures address the livelihood needs of people directly and indirectly dependent on forests. The FIP is intended also to provide lessons learnt in the period leading up to full implementation of REDD (reduced emissions from deforestation and degradation) schemes in the post 2012 period. “REDD –readiness” programs such as the Forest Carbon Partnership Facility and the UN REDD scheme have been established to help countries prepare for this. Developed countries have committed US\$ 3.3 billion to help implement REDD.

**The Global Environment Facility:** The GEF invests in a number of activities relevant to climate resilient agriculture through its operational programs on biodiversity, climate change, protection of international waters and land degradation. The most directly relevant is the land degradation program. Over the 2005-2010 period it has invested over US\$ 300 million for 87 projects, with the funding mostly blended with other operations. Support for the Terrafrica program in Africa has been a major example. **The Least Developed Countries Fund (LDCF)**, established under the UNFCCC is managed by the GEF. As of June 2010 US\$ 224 million had been mobilized for preparation and implementation of NAPAs (National adaptation plans of action). 24 countries have prepared NAPAs with over US\$ 9 million of funding assistance, and US\$ 77 million has been allocated to help with NAPA implementation in 19 countries. Most NAPAs name climate resilient agriculture and land and water management as key priorities.

A number of other funds have been established to support adaptation or improved forest management, and there is also a substantial volume of bilateral support to improved agriculture, land and water management in a climate constrained environment. The Congo Basin Fund, addressing sustainable forest management, is managed by the African Development Bank, which also supports, together with the African Union, Climdev, a program to improve the quality and accessibility of weather and climate information in Africa.

**Weather related Risk management insurance instruments** have been piloted in a number of countries. To be successful, however, they require reliable weather information and adequate systems of farmer registration. And where large numbers are affected by extreme weather events substantial funding is necessary. Mongolia has piloted these approaches for livestock, and Malawi for cropped agriculture. Systems are well established in OECD countries but there are risks of perverse incentives. In the poorest countries social protection approaches may be better adapted; the Ethiopia Productive Social Safety Nets has combined cash for work and soil/water conservation approaches, aiming to lift rural populations out of dependence on food aid.

**Opportunities from Carbon finance and Carbon Policy:** Carbon markets developed rapidly over the last 10 years, though, given the uncertainties in the global governance framework for climate change, prices are volatile. *However, despite the role of agriculture in GHG (over 30 percent), carbon payments related to agriculture have remained a very small part of the market.* Agriculture is not eligible under the Clean Development Mechanism (CDM). Even where methodologies for measuring reduced emissions or above-ground sequestration from afforestation are well established, projects, and the scale of financing, have been small. One reason is that there are many farmers and relatively small carbon payments per hectare per year (often below \$10/ha/year), resulting in high transaction costs and limited incentives for land use change. On the other hand several upcoming technologies such as the system for Rice Intensification and Zero Tillage Agriculture allow for improvements in productivity while reducing greenhouse gas emissions. While methodologies or tools exist to measure soil carbon, there is no approved carbon accounting methodology yet. Most payments have been related to reduced emissions from the livestock sector through better manure management and use of emissions for biogas. *There would be great benefits in including reduced emissions from soil carbon sequestration in future carbon trading regimes.*

Substantial progress has been made in measuring livestock-related emissions which account for about half of all agriculture/land-related emissions. Emissions for livestock include carbon dioxide but also, and more importantly, methane (CH<sub>4</sub>), as well as nitrous oxide (N<sub>2</sub>O) and ammonia (NH<sub>3</sub>). These sources of greenhouse gas emissions are already eligible for financing under current carbon market mechanisms. The challenge is to develop the programs and policy measures (see above) to help farmers in developing countries access financing “to scale”.

Progress has also been made in measuring the carbon sequestered from growing trees (afforestation and reforestation), and the work is well-advanced for the measurement of sequestration, or “avoided emissions” from improved forest management or reductions in forest degradation. The UNFCCC Conference of Parties (COP15) in Copenhagen recognized the importance of reducing emissions and increasing sequestration from these sources and there was an agreement, at least in principle, that they should be included in future carbon financing mechanisms.

**Cost-effective, landscape-based approaches to assessing the carbon footprint of agricultural and rural development operations more broadly present greater challenges.** Particularly difficult has been agreement on a land-based approach to assess of soil carbon sequestration (which has both resilience (adaptation) and reduced emissions (mitigation) benefits), from improved land and water management practices. A robust system would most likely need to integrate both direct field or in-situ measurements and model-based approaches to leverage scientific understanding to measures soil carbon stocks and changes in a broader landscape. The FAO ex-ante carbon accounting tool has been piloted in a number of countries. Using information available from UNFCCC data bases, supplemented by country or sub-national data where these exist, while still at a pilot stage it is proving to be a highly useful tool in ex-ante carbon accounting, assessing the carbon footprint of agricultural and rural development activities. It has also been shown to be quite robust when tested against field measurement techniques.

Encouragingly, models are being developed in which soil carbon measurement systems can be efficiently integrated into broader land surveillance systems for evidence-based management of land at project and national levels, simultaneously addressing food, feed, fuel, water, climate change and poverty problems, including a carbon accounting methodology for sustainable agricultural land management, which is being developed by the World Bank and has been submitted for validation to VCS. Such developments ensure that soil carbon offsets are measurable, reportable and verifiable – criteria necessary for soil carbon to be included in future carbon finance market mechanisms, which is important not only for its role in a future low carbon world, but also as incentive for environmentally responsible land and water management.

More broadly, another challenge has been long delays in certifying emissions reductions projects by UNFCCC experts (up to three years in many cases). As methodologies are approved and programs move beyond the pilot stage, the approval process should accelerate.

Finally, **with regard to carbon finance it is important to manage expectations.** Without a global agreement carbon markets will likely remain fragmented and prices low. Furthermore while carbon finance can bring down the cost of a project for a private investor (generally by 15-20 percent), it is unlikely by itself to make a project financially viable.

To address the challenge that developing countries face, to access knowledge on the various sources of funding and to implement integrated programs, a knowledge platform is under preparation jointly by the UNDP and the World Bank – in particular since there is the potential to combine different sources of finance for the development of agricultural and rural economies, and to support climate resilience, low carbon and agricultural productivity/food security objectives together.

## Annex – Country Notes

### Bangladesh Country Note: Agriculture, Food Security and Climate Change

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Bangladesh is a low lying delta located between the Himalayas to the north and the Bay of Bengal to the south, has a population of over 160 million, per capita GDP of US\$ 470.<sup>1</sup> It is one of the most climate vulnerable countries in the world, due to the frequency of extreme climate events and its high population density. Most of the country is low-lying land, with floorplains occupying 80 percent of the country. This makes it susceptible to annual inundation - normally nearly 70 percent of the country gets flooded during heavy monsoon.<sup>2</sup> The flooding problems are exacerbated by sediment transported by three major rivers- the Ganges, Brahmaputra and Meghna. These floods are frequent, and cause the greatest economic and human losses to the country.

The impacts of higher temperatures, more variable precipitation, more extreme weather events, and sea level rise are already felt in Bangladesh and will continue to intensify. The impacts also result from increased climate variability and extreme events, including more intense floods, droughts, and storms. These changes are already having major impacts on the economic performance of Bangladesh and on the lives and livelihoods of millions of poor people.

#### Agriculture and its Role in the Economy

The agricultural sector plays a critical role in food security and overall economic development in Bangladesh. It is one of the main sources of livelihood for about 73 percent of the total rural population. Furthermore, it contributes about 20 percent of GDP and employs about 63 percent of the total labor force.<sup>3</sup> Thus, the performance of this sector has considerable influence on overall growth, the trade balance, and the level and structure of poverty and malnutrition. More importantly, much of the rural population, especially the poor, is reliant on the agriculture as a critical source of livelihoods and employment.

Out of the total land area of 14 million hectares (mha) of the country, about 8 mha is arable. Total annual cropped area, cumulative of three growing seasons, is about 14 mha. Rice, the main crop and staple food of the country, is produced in about 70 percent of total cropped area. About one percent of total agricultural land is lost every year to non- agricultural use. About 60 percent of total cropped area has access to irrigation of which ground and surface water account for 83 percent and 17 percent respectively.

#### Climate Change Projections

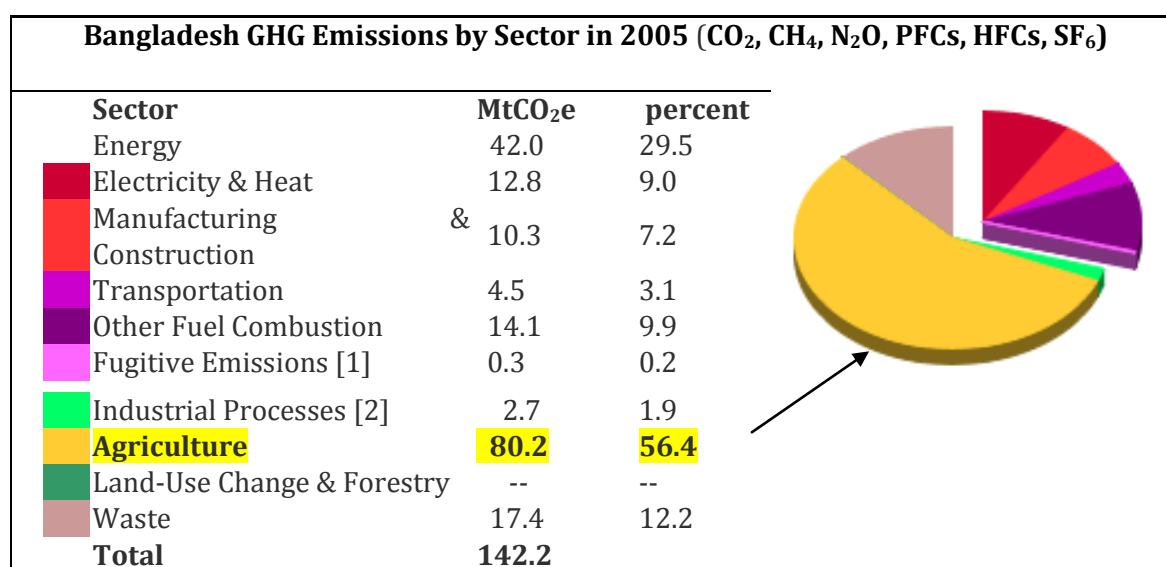
Many of the projected impacts of climate change will reinforce the baseline environmental, socio-economic and demographic stresses already faced by Bangladesh. Climate change is likely to result in:

- i. *Increased flooding, both in terms of extent and frequency, associated with sea level rise, greater monsoon precipitation and increased glacial melt:* Most of Bangladesh lies in the delta of 3 of the largest rivers in the world, and two thirds of the country is less than 5 meters above sea level. Therefore the country is susceptible to flooding from the rivers, sea level rise as well as tidal flooding during storms. In most years, 30-70 percent of the country is affected by floods. Every 4-5 years, there is a major



- flood that inundates 60 percent of the country and causes losses of life, substantial damage to infrastructure, housing, agriculture and livelihoods (Agarwala et al. 2003). Using three different scenarios of future sea level rise, the total area that perennially floods is projected to increase by 6 percent, 10 percent and 20 percent.<sup>4</sup>
- ii. *Increased salinity intrusion*: The sea level rise also causes saline intrusion up coastal rivers and into ground aquifers, which reduce the availability of fresh water. It is projected that sea level rise in Bangladesh will affect 15-17 million people and submerge 12-16 percent of the total land area by 2100 (Agarwala et al. 2003).
  - iii. *Increased vulnerability to cyclone and storm surges*: Bangladesh is the most vulnerable country in the world to tropical cyclones. The storm surges tend to be higher than in neighbouring countries because the Bay of Bengal narrows towards the north, where Bangladesh is located.
  - iv. *Increased moisture stress during dry periods leading to increased drought*: droughts in Bangladesh are seasonal and commonly affect the northwestern region, which generally has lower rainfall than the rest of the country, which is expected to increase due to climate change.
  - v. *Greater temperature extremes*

### Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions



### Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security

Since agriculture is the mainstay for the economy, Bangladesh is very sensitive to impacts on the agricultural sector, which will inevitably have effects on the food security of the most vulnerable groups.

The impacts of climate change could affect agriculture in Bangladesh in many ways, and climate unpredictability will make planning of farm operations more difficult. The predicted sea-level rise will threaten valuable coastal agricultural land, particularly in low-lying areas, including the biodiversity in some of the most fragile environments, such as sunder bans and tropical forests.

Prolonged inundation, increased drought, salinity and loss of land due to erosion are the enhanced risks facing agriculture due to changes in climate. Increased droughts and salinization in the dry season and prolonged inundation in the wet season will change the areas suitable for growing rice, which is Bangladesh's main agricultural good.

Climate variability and change are clearly critical development issues for Bangladesh. The combination of frequent natural disasters, high population density and growth, and low resilience against economic shocks, makes Bangladesh particularly vulnerable to these climatic risks.

### **Government Strategies for Agriculture, Food Security and Climate Resilience**

Bangladesh is at the forefront in climate change adaptation. The government has taken several initiatives particularly for adaptation and has managed to draw international attention and cooperation to address climate change adaptation in Bangladesh. The government has submitted the Initial National Communication to UNFCCC in October 2002 and is now preparing its second national communication which will be completed by this year.

Bangladesh has emphasized that the specific interventions within the country have to be within the framework of ensuring the security of food, water, energy and livelihoods. The government strategy is to integrate climate change challenges and opportunities into the overall development plan and programs involving all sectors and processes for economic and social development.

### **National Climate Change Policies and Strategies**

The country launched the **National Adaptation Program of Action (NAPA)** in 2005 which identified 15 priority activities, including general awareness raising, capacity building, and implementation of projects in vulnerable regions with special focus on agriculture and water resources. NAPA was further updated in 2009 and identified 45 adaptation measures with 18 immediate and medium term adaptation measures.

The government also prepared the **Bangladesh Climate Change Strategy and Action Plan (BCCSAP)** in 2008 and further revised in 2009. This is a comprehensive strategy to address the climate change challenges in Bangladesh and has six thematic areas: (a) food security, social protection and health; (b) comprehensive disaster management; (c) infrastructure development; (d) research and knowledge management; (e) mitigation and low-carbon development; and (f) capacity building and institutional strengthening. Forty four programs have been identified and prioritized within these six thematic areas.

Given the vulnerability to frequent natural disasters, government has also made significant progress in policies and investments for reducing disaster risks. It has drafted the **National Plan for Disaster Management (NPDM)** in 2008 for addressing disaster risk reduction and climate change adaptation comprehensively.

### **Mainstreaming Climate Adaptation in Key National Policies**

In the recent **Bangladesh Second Poverty Reduction Strategy Paper (PRSP-2)**, one of the supporting strategies emphasizes mainstreaming and strengthening climate change adaptation across various sectors including *improved crop production practices, watershed management*, and particularly in the coastal zone it emphasizes increasing *afforestation*, building cyclone

shelters and embankments, improving salinity control measures, enhancing public awareness, climate research, and data collection.

There are a number of other national policies which partially address the new dimension of climate change:

- **National Water Policy (NWP) 1999** provided the first comprehensive look at short, medium and long term perspectives for managing water resources in Bangladesh.
- **National Water Management Plan (NWMP) 2001** examines the implementation and investment responses to address the priorities identified in the NWP. The NWMP indicates that climate change is one of the factors determining future water supply, including the impacts of sea level rise.
- The Draft **National Disaster Management Policy (2008)** integrates disaster risk reduction approach and climate change adaptation in all development plans, programs and policies.
- Other national policies including Bangladesh Environmental Policy (1992), National Food Policy (2006), National Environmental Management Action Plan (1995), National Land Use Policy (2001), National Forest Policy (1994), Fisheries Policy (1998), National Energy Policy (1996), National Health Policy (2000) do not explicitly address climate change issues but provide the scope for addressing this agenda.

### Other Agriculture Sector Initiatives

The **National Agriculture Policy (1999)** integrates issues on climate change adaptation and disaster risk management. Bangladesh's agricultural strategy includes measures for technological innovation, diversification from rice into higher value livestock, fisheries and horticulture, and land and water management. Disaster management forms a key part of its strategy, with 6 million ha of agricultural land under some form of protection.

The government has initiated a number of agricultural programs such as the development and distribution of drought and saline resistant rice varieties to enhance year round production. Scientists at the Bangladesh Rice Research Institute (BRRI) have developed salinity-tolerant rice varieties, including BRRI Dhan 47 for coastal areas of the country where crop lands are susceptible to sea water intrusion. High yielding, submergence tolerant and short-duration (110-120 days) rice varieties are making a huge difference in boosting food security. BRRI is also developing drought-tolerant varieties of rice for release in the near future.

In addition to the infrastructural provision by the government, the Bangladesh coastal community has over the years adapted community based activities to address disasters. Based on past experience, they have developed several indigenous coping techniques, such as developing floating gardens (locally called 'baira') to cultivate vegetables.

### Programs to Support Climate-Smart Agriculture

With IDA assistance, the government of Bangladesh is implementing two major national programs to increase agricultural yield. The Bank, with co-financing from IFAD, (IDA US\$ 62.6 million and IFAD US\$ 19.4 million), is supporting the Government in the implementation of **National Agriculture Technology Project (NATP)**, which was launched in May this year. The NATP is the first five year phase of a 15 year Adaptable Program Loan Program to support the generation, dissemination and adoption of agriculture technology in

crop, livestock and fisheries sub-sectors. The overall objective of the NATP is to support the government's strategy to improve agricultural productivity and farm income by revitalizing the national agricultural technology. The **National Water Management Improvement Program (WMIP)** supports the initiatives of capacity building for flood control, drainage and irrigation through physical rehabilitation and institutional reforms of the two main national water resource agencies.

The **Second Social Investment Program Empowerment and Livelihood Project (2010-2016)** has a budget of US\$ 120 million. The project is consistent with the Bangladesh Country Assistance Strategy (CAS) 2006-2010, which addressed improved investment climate and economic empowerment as the cornerstones of a poverty reduction strategy; and is fully aligned with the new CAS (2010-13) currently under preparation, that draws strongly from the government's key priority areas for the country's economic growth strategy. Its key objectives are to assist government of Bangladesh to increase competitiveness and sustain growth; to improve access to service delivery and social safety nets for the poor; increase agricultural growth to improve food security; and implement effective climate and disaster risk management measures to reduce vulnerability. These objectives are closely aligned with, and will contribute to the government's and IDA's strategic priorities, to bring vibrancy to agriculture and rural life, with an extension of the social safety net system to effectively capture the ultra poor.

The development objective of the project is to improve the livelihoods, quality of life and resilience to climate variability, natural hazards and other shocks of the rural poor. The *community and livelihoods development component* will mobilize and empower the poorest and most vulnerable households, build and strengthen pro-poor community institutions; and fund village development and livelihood related investments incorporating risk reduction plans. The *institutional development and livelihoods promotion component* will promote inter-village development to consolidate and sustain livelihood activities and investments generated at the village level, promote business and establish market and informational linkages for community organizations, and facilitate job creation. The *capacity development and partnership building component* will strengthen the capacity of the implementing agency and other relevant partner agencies to deliver services and build linkages and synergy with the local governments and other public and private sector agencies; and support innovative and replicable interventions on a pilot basis in the areas of Community Driven Development (CDD) approach, local level governance, climate risk management and community adaptation, environmental sustainability and livelihood development.

At the government's request, the World Bank is now preparing an **Emergency Cyclone Recovery and Restoration Project (ECRRP)** (approximately US\$ 109 million) which would include provisions for improving sustainable agriculture production in cyclone affected areas in the medium-to-long term, to enhance food security. The project includes support for agriculture recovery through sustainable crop, livestock and fisheries production and productivity enhancement in the cyclone affected areas.

The government of Bangladesh has requested the World Bank to provide budget-support under its fast-track **Global Food Response Program (GFRP)** facility, to assist the government's measures to maintain macroeconomic stability, ensure food security in the immediate short-run, and help those affected by rising food prices. The **Food Crisis**

**Development Support Credit Project**, is the proposed operation under the GFRP and aims to provide a US\$ 130 million budget support credit to help the government of Bangladesh cushion the fiscal pressure arising from the additional safety net support that is being provided to protect the basic consumption needs of the poor. Together with the government of Bangladesh, the project seeks to reduce the impact on the most vulnerable groups, through a number of actions:

- food grain, particularly rice, is being made available to the poor at subsidized prices;
- existing safety net programs are being scaled up;
- a new safety net program, an employment guarantee scheme, has been initiated to help people in distressed areas-such as those that periodically suffer from extreme food shortages, known in the local dialect as Monga-obtain employment during lean agricultural periods; and
- ensuring the adequate and timely availability of farm inputs including seeds, fertilizer and diesel to farmers.

The World Bank recently published a book entitled “**Climate Change Risks and Food Security in Bangladesh**”, to serve as a useful guide to Bangladesh as they are faced with the challenge of achieving food security amidst a variable climate. The integrated framework used in the analysis is needed to better understand the relative impacts from multiple climate risks (e.g. floods, droughts, climate change) and how these relate in the context of an evolving socio-economic baseline (e.g. population, prices, international trade). The book has provided an assessment approach to help sharpen the critical policies and interventions by the Bangladesh government.

## **China Country Note: Agriculture, Food Security and Climate Change**

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### **Structure of Agriculture and its Role in the Economy**

Agriculture contributes about 13 percent to China's GDP. Average annual agricultural GDP growth over the last ten years has been around 6 percent, which is high by international standards but below growth rates in other sectors in China. There are about 700 million small scale farmers (or about 250 million farm families) in China today which live on farms that are less than 1 hectare. About 150 million farmers have incomes below the Bank's poverty line and remain dependent on agriculture for the most part of their livelihood.<sup>5</sup> Major achievements have been made over the past two decades in improving agricultural productivity through increasing crop yields, developing irrigation infrastructure, introducing new technologies, diversifying into higher value crops, integrating domestic markets, and increasing international competitiveness and food exports.

Despite these successes and despite large-scale rural to urban migration, strong agriculture growth needs to be maintained to help raise rural incomes and bridge the rural-urban income gap. This will require linking small farmers to domestic and global markets through technology improvements, value chain integration, standardization of agricultural products, foods safety, plant and animal health improvements, tenure security, better environmental management, institutional development and other measures. In addition, climate change adaptation, the reduction of GHG emissions from agriculture, and the management of the environmental footprint of agriculture pose major challenges.

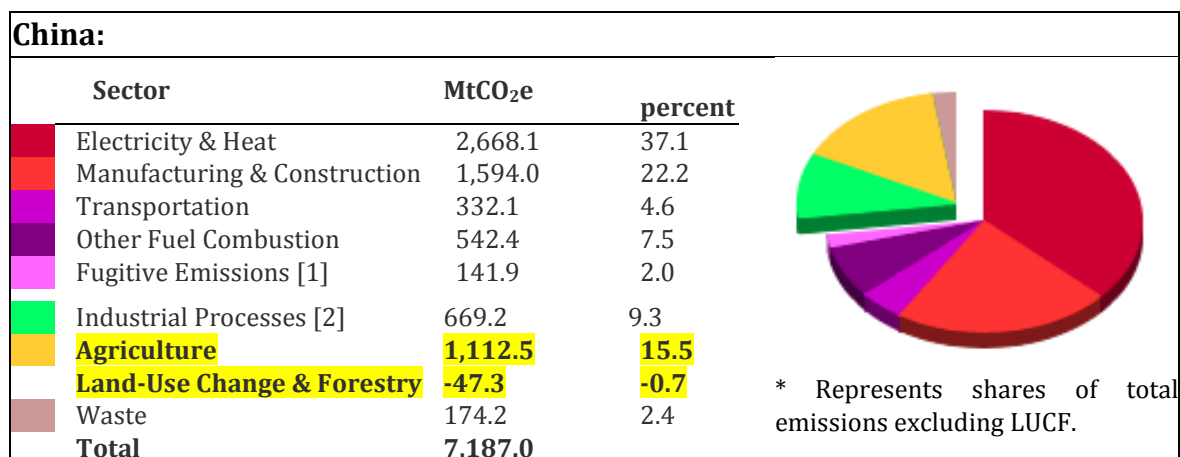
### **Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security**

Climate change is expected to affect agricultural production, agricultural prices and trade and grain self-sufficiency. Studies for major grain producing regions project an increase in temperature, greater variability in precipitation, prolonged seasonal droughts, and increased water stress due to decreasing water availability and increasing demand. Water scarcity is predicted to lead to water reallocation and more efficiency measures as well as changes in cropping patterns. Producer and market responses are likely to partly offset the impacts of climate change on crop production. Trade could also help China mitigate the impacts of climate change. However, trade accounts for only a small share of China's total grain demand and overall impact of increased trade on grain self-sufficiency is expected to be small. The effects of climate change on farmers will vary with rain-fed areas likely to be more vulnerable than irrigated areas.

### **Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions**

Non-point source pollution from agriculture has become the biggest source of water contamination and is a major source of air pollution and contributor to GHG emissions in China. Improper use of fertilizers as well as improper production and use of pesticides in combination with the fast developing livestock and aquaculture sectors are the causes for the high levels of pollution. There is great potential to reduce GHG emissions from agriculture, which are estimated to account for about 15 percent of China's total GHG emissions (CO<sub>2</sub> equivalent). Within agriculture, 55 percent of emissions come from nitrous oxide, and 45 percent come from methane. How to successfully address the environmental footprint of agriculture, how to ensure ecological and environmental sustainability of agriculture

production systems and how to move towards a low-carbon agriculture are all major challenges for the future.



Source: World Resources Institute (<http://cait.wri.org>)

### Government Strategies for Agriculture, Food Security and Climate Resilience

China's priorities for the agriculture sector cover the continued modernization of the sector through market development, technical innovation and intensification, food safety, coordinated regional development along comparative advantages, more efficient allocation of agricultural production land and ensuring land tenure security, disaster management and adaptation to climate change, and low-carbon agriculture. The Government's comprehensive sustainable agriculture development strategy promotes shifting of away from simple quantitative production targets to more balanced and efficient production, while maintaining the overall objective of food security. It promotes environmentally-friendly and resource-conserving agriculture, the expansion of irrigated lands, and a transitional from household-based production to more organized agricultural production along sophisticated value-chains and market integration.

Within its strategy, the Government is pursuing a climate change strategy that seeks to strengthen the resilience of agriculture to climate change and, at the same time, reduce the emission of greenhouse gases from agriculture. The Government has made progress in introducing climate adaptation and mitigation technologies in key national grain production areas (such as changing cropping patterns, increasing investment in irrigation infrastructure, using water saving technologies and planting new crop varieties to increase resilience to climatic shocks), regions under stress from water shortages, and ecologically fragile areas, such as ecological rehabilitation and development and coastal areas. Efforts have also been made to increase public investment in climate change research. To combat low fertilizer use efficiency in China, the government in recent years has begun promoting technology aimed at calibrating fertilizer dosages according to the characteristics of soil. In addition, conservation tillage has been considered as a potential way to create carbon sinks. Finally, extending intermittent irrigation and adopting new seed varieties for paddy fields are also strategies that have been supported and promoted as part of the effort to reduce GHG emissions.

### Programs to Support Climate-Smart Agriculture: Successes and Challenges

The Bank is supporting China's agriculture sector in a number of key areas: In its *Agriculture Technology Project* and *Jilin Food Safety Project*, innovations are being introduced to assist in the integration of smallholders into markets and promote a reorientation of government in



agriculture away from being a direct actor towards a service provider. These include value chain development, technology innovation and transfer, farmer associations, new forms of agribusiness financing, risk and benefit sharing partnerships between smallholders and private sector, and extension service delivery and monitoring in form of public-private partnerships, development of good agricultural practices (standards) to improve quality and safety of products (matching grants schemes) and infrastructure and support for risk-based food safety monitoring.

As part of its *Irrigated Agriculture Intensification Project (IAIL3)*, the Bank is supporting a number of innovative demonstration and learning interventions with GEF grant financing, including a *Climate Change, Water Security and Agricultural Development in the 3H Region Study*, the *Mainstreaming Climate Change Adaptation in Irrigated Agriculture Project* that complements the ongoing IAIL3 lending operation that is taking climate change models down to the micro level and using these models to design better irrigation and water saving interventions at the project level; and the *GEF-financed Sustainable Land Management and Adaptation Component under the Sustainable Development in Poor Rural Areas Project*.

A new *Comprehensive Agriculture Development Project* has been proposed by Government for Bank support in the coming years. This project would cover key grain production provinces and include large-scale investments in various agricultural sub-sectors to improve land and water productivity, crop yields, fertilizer applications, and rural energy use efficiencies. The project offers an important opportunity to up-scale the experiences and lessons from the ongoing climate change adaptation and mitigation pilots.

On the mitigation side, the Bank is implementing a number of Clean Development Mechanism (CDM) projects, including the *Hubei Eco-Farming Biogas Project*, *Shandong Provincial Biogas Program*, and *Xinjiang Aksu Pig Farm Biogas Project*. Furthermore, the Bank maintains a well established and diverse portfolio in the field of agriculture pollution prevention, including the *Eco-Farming* and *Henan Yellow River Ecological Livestock Projects* (both IBRD), and the *Shanghai Non-Point Source Agricultural Pollution Project* (GEF). Elements of agriculture pollution control are also supported under the *IAIL3*, and the *Jilin Food Safety and Agriculture Technology Projects*. Issues being addressed include the management of animal waste, promotion of biogas use, non-point source pollution reduction, good agricultural practices, monitoring ambient environmental conditions that affect food quality, heavy metal contamination of soils, animal disease outbreaks, and organic production. The earlier *Coastal Zone Management Project* established monitoring systems for pollution into coastal waters and fish populations to sustainably manage these resources. There are also a number of environmental projects that tackle agriculture run-off into river and lake systems. Finally the Bank is maintaining its largest POPs program in China.

### **Opportunities Ahead**

China will have to make great efforts to respond to the challenge of climate change while maintaining a focus on food security and poverty reduction. This will have to include legislative and policy reforms, particularly with regard to water resource management and pollution control, investments in irrigation infrastructure as well as the provision of extension services and access to knowledge for farmers to cope with and develop their own adaptation measures.



## **Morocco Country Note: Agriculture, Food Security and Climate Change**

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### **Agriculture and its Role in the Economy**

A large share of the Moroccan population is employed in agriculture, yet the low performance of the agricultural sector results in a limited contribution to the national economy. Agriculture in Morocco occupies one person out of two, employing up to 80 percent of the labor force in rural areas. However, the low agricultural productivity translates into the sector contributing to Morocco's GDP by 15 percent only.

Under rainfed agriculture, the lower-than-potential performance of can be explained through a variety of factors. Low productivity in rainfed areas, which represent 85 percent of the agricultural land, is primarily due to low and erratic rainfalls. For example, wheat, a major rainfed crop in the country, records strong yield fluctuations from one year to the other. Over the last 30 years, average wheat yield never exceeded 2 ton/ha, and in dryer years went down up to half a ton/ha.<sup>6</sup> The effect of rainfall fluctuation on agricultural production explains 75 percent of the year-to-year variability in national GDP. Another factor affecting agricultural performance is the unequal distribution of agricultural land, with 70 percent of farmers owning only 26 percent of cultivated land. These semi-subsistence farmers make limited use of modern technologies (they are mostly rainfed farmers), often have a low education level (more than 45 percent of the heads of farming families are over 55 years old, and 81 percent are illiterate), and lack technical know-how. Overall, the low performance results in small agricultural and rural incomes, poor diversification of rural household incomes, and disguised unemployment.

Irrigated agriculture in Morocco is crucial for agricultural exports, but it is limited by shrinking water resources. Irrigated agriculture contributes largely to exports, producing tomatoes, citrus (oranges, tangerines, and mandarins), fruits and vegetables (peaches, strawberries, melons) among other products. It contributes 50 percent of the country's agricultural added value, and up to 75 percent in drought years. Exports of the agri-food sector are supported at political level through Morocco's Advanced Association Status with the EU and bilateral agricultural trade liberalization. However, water resources constraint the development of irrigated agriculture. Water is exploited beyond its renewable limits, and the expansion of irrigated areas is not an adequate solution. Agriculture, which currently accounts for 87 percent of water use, suffers from increasing competition from urban and industrial demands. In irrigated agriculture, productivity is undermined by farmers' uncertainty about water supply, water scarcity being a key factor in lower-than-potential agricultural revenues. Introduction of more efficient irrigation techniques can help sustain production while conserving water resources.

### **Climate Change Projections**

Climate change is a reality in Morocco, with recorded changes in both temperature and precipitation. Since the 1960s, annual mean temperatures have increased by 0.16 °C per decade, and there has been a significant decrease in the number of cold days. Despite the rainfall variability typical of the region, there are signs that precipitation is decreasing. At national level, spring rainfall has declined by over 40 percent, and the maximum dry-spell length has increased by 15 days. Monthly rainfall totals for the Oum er Rbia and Tensift river basins in the Atlas Mountains have declined.

Notwithstanding climate change projections are characterized by a certain degree of uncertainty, we can conclude that Morocco will become drier and hotter. Compared to other areas of the World, North Africa - including Morocco - is characterized by a high agreement among different scenarios. Based on an ensemble of 22 GCMs from the most recent IPCC Fourth Assessment Report mean annual temperature is expected to increase 4°C in inland areas and 2°C in coastal areas of Morocco by the end of the century. Over the same period, winter precipitation is expected to decrease by 20 to 40 percent. Drought years will become disproportionately more severe. Downscaling at river basin level suggests that different areas of Morocco will be affected with different intensity by climate change, with the marginal areas being those which are going to suffer the most.

Besides experiencing the negative effects of climate change, the agriculture and forestry sectors contribute to Morocco's GHG emissions, accounting for 33 percent of the national emissions or a total of 32 kilotons.<sup>7</sup>

### **Main Threats Posed by Climate Change to Agriculture and Food Security**

Climate change will affect both rain-fed and irrigated agriculture in Morocco. The warmer climate will increase evapotranspiration. This could produce yield gains in irrigated vegetable, fruit, and fodder crops, if additional water is made available to cover the increasing irrigation demand. However, water volumes in storage facilities will probably decline, due to lower precipitation and more that proportional reduction in runoff. Lower precipitation and increased variability will affect rainfed crops such as wheat, barley, and olives. However, the quantification of possible yield reduction remains an open question.

Climate change in Morocco could raise concerns about food security. Reduction in cereal yields could induce the increasing dependence on food imports. This would make Morocco more vulnerable to increasingly volatile international food prices. Morocco currently depends on imports for about 50 percent of its cereal needs. Increasing domestic production would have significant opportunities costs, since the scarce land, water, and labor resources currently employed in cereal production would have a higher pay-off if allocated to other activities. Climate change will intensify the tension between the competing objectives of maximizing returns to land and water and reducing dependency to food imports. Recent modeling done by the World Bank shows that Morocco would be capable of achieving 85 percent self-sufficiency with present yields, by diverting land from high value crops to cereal production. With a 30 percent increase in cereal yields, Morocco could achieve cereal self-sufficiency in the present, and with 40 percent increase, achieve self-sufficiency until 2022.<sup>8</sup> An alternative would be to invest towards high value crops for international trade, shifting the focus from being self-sufficient to be self-secure. However, increasing foreign exchange would require opening appropriate market channels.

### **Government Strategies for Agriculture, Food Security and Climate Resilience**

In 2008, Morocco has launched its new national agricultural strategy, called the *Plan Maroc Vert* (PMV). The PMV seeks to make agriculture the driving force for economic growth. The PMV aims to double agriculture's value added within a decade through a comprehensive overhauling of the sector's structure in terms of cropping patterns, land tenure, and agricultural taxation. The PMV disaggregates sector goals into two pillars. Pillar I promotes high growth in the irrigated, competitive sector of high-value exports, opening the sector

economy to international trade. Pillar II aims to reduce rural poverty in the low productivity rainfed sector.

Climate change will make achieving the objectives of the PMV more challenging. Reductions in the availability of water will jeopardize the prospects of irrigated agriculture. This will reduce the advantage of high productive farming. In marginal areas, drought and mid- to long-term declines in agricultural yields will affect the livelihoods of rural communities, making it more difficult to reduce rural poverty.

Notwithstanding the PMV does not directly address climate change, many of the actions envisaged can have an adaptation effect. For example, the conversion of 555,000 ha of surface irrigation to drip irrigation could contribute to save consistent amounts of water. Upon completion of the program, the total irrigated area with pressurized irrigation is to cover 700,000 ha, close to 50 percent of the surface equipped for irrigation in Morocco.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

The World Bank is supporting the PMV through a Policy Development Loan (DPL). Many of the policy changes in the DPL can result in increased resilience of the agricultural sector to climate change. Besides promoting the conversion to more efficient irrigation strategies, the DPL aims to improve the governance and public financial management of the Pillar II projects for smallholder farmers. The vast majority of the rural poor are smallholders with little or no access to irrigation, credit, or agro-chemicals. These inputs and technologies typically help in smoothing the effects of climate variability. As climate shocks will become more frequent under the future climate change, the DPL aims at increasing the means of smallholders and their resilience to climate change.

The World Bank is trying to enhance the Moroccan agriculture sector's resilience to climate change by incorporating a climate-change adaptation dimension into the implementation of the PMV. A project financed by the Global Environmental Facility through the World Bank aims specifically at addressing the knowledge and capacity gap of stakeholders to face the new climate scenario. The project will support the adoption of climate change adaptation measures in strategically selected PMV projects, which will serve as a catalyst for the spread of climate-resilient techniques in vulnerable areas of Morocco. These projects will provide a demonstration of the advantage of strategies that reduce vulnerability to climate change, encouraging farmers in areas surrounding the project target zone to adopt similar measures.

The World Bank also supports activities at river basin level. The Modernization of Irrigated Agriculture in the Oum Er Rbia Basin aims at increasing the productivity and to promote more sustainable use of irrigation water in the river basin. The area is fundamental for agricultural production, as the Oum Er Rbia river supplies water to half of Morocco's large scale irrigated areas, accounting for 60 percent the country's sugar beet, 40 percent of olives and 40 percent of the milk.

### **Opportunities Ahead**

While several of the effects of climate change will be more pronounced in later decades, Morocco needs to act now. From an adaptation perspective, there is the needed for a more explicit focus on climate change in the PMV's regional plans. Targeted climate-oriented research and extension are needed. Climate change needs to be taken into consideration in the planning and design of infrastructure serving irrigation. Political actions are needed to

comprehensively tackle the relationships between climate change and food security. With reference to mitigation, the agricultural sector can offer a significant contribution in terms of reduction of GHG emissions and increase in soil carbon storage. The World Bank is starting a dialogue with the Government of Morocco to assess the best way to unlock this potential.

## **Yemen Country Note: Agriculture, Food Security and Climate Change**

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### **Agriculture and its Role in the Economy**

Farmers in Yemen have to cope with harsh natural conditions, including lack of arable land, poor soils, chronic scarcity of water, and periodic floods. The cultivable land represents only about 7 percent of Yemen. Agriculture is mainly restricted to plateaus of the basins in highlands (by rainfed and groundwater irrigation), coastal floodplains of wadis (by spate irrigation), and terraces on the sides of the mountains (by rainfed and water-harvesting). Land is often steep, badly eroded, and with little organic matter. Average annual rainfall is around 160 mm, but this does not represent the extreme variability of the country ecosystems. Water availability is erratic, with recurrent droughts and floods.

Agriculture is important in the Yemenis' life, but its economic return is limited. More than 70 percent of the country population is rural, and 53 percent depends on agriculture for income. However, the contribution of the agricultural sector to GDP is limited to 15 percent, reflecting underemployment and low productivity of workers and factors of production. Rural areas have lower incomes and poorer standards of living compared to urban areas. In 2000, only 30 percent of rural population had access to improved sanitation, versus 88 percent of urban population. Food insecurity is estimated at 37.3 percent in rural areas in Yemen, whereas it is 17.7 percent in urban areas. However, in terms of absolute population numbers, 6.3 million in urban areas are food insecure, while there are 1.1 million food insecure people living in rural areas.

Irrigation plays a significant role in Yemeni agriculture, but its beneficial effect on food production is restricted by low performances and qat cultivation. Agriculture uses about 90 percent of water resources, and irrigation covers about 40 percent of the cultivated areas. Irrigation is mainly practiced by flood irrigation (basin or fallow), with low efficiency ranging from 35 to 45 percent. Drip irrigation has been introduced in demonstration plots only, and the high cost of sprinklers limits their adoption to few farms across the country. Qat is the main cash crop; it is a mild stimulant chewed by many Yemenis on a daily basis, but not exported significantly because it is highly perishable. Qat covers about 10 percent of the total cultivated area, and consumes 40 percent of the irrigation water. Over the last 25 years, the area under qat more than tripled, with consequent negative effects on water use.

### **Climate Change Projections**

The effects of climate change in Yemen are uncertain, but higher temperatures and more variable rainfalls can be expected. There is no consensus among the 21 global climate models in the IPCC Fourth Assessment Report about the sign of the projected changes in winter, summer, or annual rainfall or its distribution pattern over Yemen (Wilby, 2008). Yemen has a complex situation as the country lies in the latitudinal band where global circulation models differ in projected precipitation trends. The effect of complex topography of the highlands is poorly modeled in current global climate models and there are few, if any, regional climate models that provide detailed scenarios for Yemen. Although there is a wide divergence in projections of the trend of average annual and seasonal rainfall, there is general agreement amongst the models that temperatures will steadily rise, and that there is likely to be an increase in variability of rainfall including extreme events.

The agriculture and forestry sectors contribute to Yemen's GHG emissions, accounting for 37 percent of the total GHG emission in the country (1995 numbers).<sup>9</sup>

### **Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security**

The Yemen's Draft National Food Security Strategy Paper (NFSSP) indicates an alarming state of food insecurity at both macro- and household levels. Yemen's food insecurity is among the highest in the world. More than 90 percent of households are net food buyers, and food insecurity (in terms of per capita calorie intake) is estimated at 32 percent of the population, mainly concentrated in rural areas. The prevalence of child malnutrition is extremely high: over 40 percent of children are moderately underweight and over 57 percent are moderately stunted.

Food security in Yemen is undermined by limited internal production, high prices, poor supply chain efficiency, and lack of national food reserves. Notwithstanding cereals cover 58 percent of the total cultivated area, Yemen is a strong cereal importer. Yemen produces less than 20 percent of the wheat it consumes. In market year (MY) 2009 Wheat Imports/Wheat Consumption were 85 percent and in market year 2010, 82 percent, according to the USDA. Food prices in Yemen will increase over the long-term, reflecting higher world prices, declining oil exports, and weakening exchange rate. While higher prices would increase incentives for domestic food production, the capacity of agriculture to respond is limited. The efficiency of the cereal supply chain in Yemen is affected by archaic procurement. The low flexibility affects the steady supply of cereals, especially in periods of high competitiveness. Yemen has virtually no wheat reserves, offering no buffer to volatility of international markets.

Food insecurity in Yemen is expected to increase under climate change, due to lower and more variable internal productions. Under higher temperatures and more variable rainfall events, irrigated agriculture will be threatened by groundwater depletion, while rainfed agriculture will be dwindling due to flood and draught extremes. Floods will result in soil erosion, damages to agriculture infrastructure, and losses in rural economy. If groundwater abstraction continued in the same rate (two and half time more than recharge) people living in the highlands (65 percent of the total population) will be forced to leave their homes leading to possible economic crisis and social unrest in the country. A pessimistic climatic change scenario with no adaptation action would exaggerate price rises and food insecurity and would push several million people below the poverty line, with direct consequences on health and malnutrition. The livestock sector which plays a critical role in food security strategies will also likely be impacted by climate change as a consequence of changes in pasture productivity, nomadic livestock patterns and increased disease burdens.

### **Government Strategies for Agriculture, Food Security and Climate Resilience**

The Yemeni agricultural strategy aims at promoting economic growth through diversification of the base economy, provision of basic services, and improvement of efficiency in agriculture and fisheries. It is the goal to reach annual growth rates targets of 5.4 percent and 7.8 percent for the agricultural sector and the fisheries sector respectively.

Food security is a high priority in the Yemeni Government, which created a Food Security Council in 2007. Presently the EU is assisting Yemen in the establishment of a Food Security



Secretariat to which a series of ad hoc task forces chaired by line Ministries will be attached. The Yemen-EC Country Strategy Paper (CSP) 2007 – 2013 highlights the continued need to support food security measures in Yemen, in line with other development cooperation activities. Recently, €7 million was allocated for the Multi-annual Indicative Program (MIP) 2007 – 2010, which might be indicating support for a sectoral approach.

An Inter-Ministerial Committee for Climate Change Coordination (IMCCC) has been set up in response to the need for institutional strengthening and capacity building in climate related issues and streamline and coordinate cross-sectoral activities. This shows a strong political commitment, beyond the traditional entities, for coordinating and nurturing mainstreaming of climate resilience into the overall development program of Yemen. The 4<sup>th</sup> Five-Year Socio-Economic and Development Plan for Yemen (2010-2015) is being finalized, climate change is expected to be mainstreamed into development planning in this plan.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

Three World Bank studies have been done for Yemen on modeling climate change and agriculture: (i) An Evaluation of Climate Data and Downscaling Options for Yemen (Wilby, 2009; Dresden, 2009); (ii) Climate Modeling for Rainfed Highlands of Yemen (Bernhoffer and Baarfus, 2009), and (iii) Assessing the Impacts of Climate Change and Variability on the Water and Agriculture Sectors, and the Policy Implications (World Bank, 2010).

The World Bank is involved in a series of agricultural and water projects such as (i) the Groundwater and Soil Conservation Project (GSCP, US\$40 million plus additional financing of US\$15 million) to be closed on October 31, 2011, (ii) Sana'a Basin Water Management Project (US\$24 million) closed on June 30, 2010, and (iii) Water Sector Support Project (US\$90 million) become effective on December 15, 2009.

The World Bank and IFAD are financing the Rainfed Agriculture and Livestock Project (RALP) which is being implemented over 5 governorates and aims to preserve and improve traditional cereal seeds through traditional seed producer associations; soil and water conservation; and improvement in livestock practices (US\$36 million, including US\$20 million from the World Bank and US\$16 million from IFAD and will close in June 2012). The Agro-biodiversity and Climate Adaptation project (US\$5 million with US\$4 million from the GEF) will start in August 2010 will complement the GSCP and RALP to develop coping options for farmers to deal with climate change, and will develop a Climate Resilient Strategy for Rainfed Agriculture.

Building on the Draft National Food Security Strategy Paper (NFSSP), the EU, IFAD, the World Bank and other partners are providing assistance to Yemen as part of the Global Agricultural Food Security Program.

### **Opportunities Ahead**

Addressing the food security challenges requires a mix of policy reforms and scaling up of food security enhancing investments. The reduction of fuel subsidies, qat consumption, and groundwater use are essential policy measures that need to be addressed to take on the food security challenge in Yemen. However, preliminary analysis shows that rising fuel prices will increase poverty and limiting groundwater use will reduce food production and agricultural incomes in the short and medium run. In addition, traditional farmers, growing cereals, will

shift to qat productions which are the only lucrative plants that can cover high production cost. While the suggested policy reforms are inevitable and important for improving long-term food security, there is need for complementing these reforms with investment projects and programs (i)to secure food availability at national level starting with assessing national cereal supply chain in Yemen, (ii) increase rural non-farm income to improve access to food at household level, (iii) reduce groundwater use for agriculture and increasing soil and water productivity, and (iv) improve health and nutrition awareness, family planning and targeting of social transfer.



## **Niger Country Note: Agriculture, Food Security and Climate Change**

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### **The Role of Agriculture and Key Vulnerabilities**

Niger is a Sahelian country with a land area of 1.27 km<sup>2</sup>. Rainfall averages less than 150 mms over 77 percent of the land area. Rainfall averages 300 -600 mms over 10 percent of the country and more than 600 mms over 1 percent. Irrigated agriculture is practiced along the river Niger in the south-west of the country, and in the Chad Basin in the south-east, and there are substantial groundwater reserves. The rainy season is generally short and intense, lasting from June to September. Average maximum and minimum temperatures have shown an upward trend over the last 20 years, while rainfall has shown increasing annual variability, with an increase in the frequency of dry years since 1970. 84 percent of the population is dependent for livelihoods on agriculture, livestock, forestry or fisheries and these climate-vulnerable sectors comprise 46 percent of GDP.

Niger's population is currently estimated at 15.3 million, with an annual growth rate of 3.3 percent. Per capita GNP is estimated at US\$ 320, and the Human Development Index places Niger at the bottom of 182 countries analyzed. 50 percent of the population suffers periodically from food insecurity, and the 2009-2010 drought has brought famine to many areas in the east and south of the country in recent months. Although Niger has a system in place for emergencies, recent political instability has affected delivery of food relief.

Niger's agricultural production is highly dependent on rainfed production (cereals and legumes), on livestock for meat and milk, with a limited number of cash crops (e.g. onions, cowpeas and hides and skins). The livestock sector comprises over 13 percent of GDP. Production systems are extensive with limited access to modern technology or post harvest conservation systems: only 1.4 percent of cultivated land is currently irrigated, and less than 5 percent receives any fertilizer. Crops are highly vulnerable also to pests, particularly to locust outbreaks. On average cereal production meets 96 percent of requirements but there are wide annual fluctuations in production. Fallow periods and farm size are being reduced as population increases. Fewer than 10 percent of households nation-wide have access to electricity (35 in rural areas) and 96 percent of households use wood and charcoal for cooking, placing additional pressure on the natural resource base.

Overall GHG emissions are low in Niger, only 0.1 tons per capita, 10 percent of the average for Sub-Saharan Africa, but 78 percent of the total GHG emissions can be attributed to agriculture.

### **Government Strategies for Agriculture, Food Security and Climate Resilience**

The Government of Niger's overall development strategy for the 2008-2012 period is outlined in its Accelerated Poverty Reduction Strategy Paper (APRSP) and related Rural Development Strategy (RDS). The APRSP emphasizes the constraints to growth and poverty reduction outlined above. Its development strategy is focused around four pillars:

- (i) intensification of agriculture and stock-breeding;
- (ii) diversification of sources of economic growth;
- (iii) control of population growth; and
- (iv) effective social programs.

The strategies support programs which improve land and water management, enhance livestock productivity, support irrigated agriculture, access to improved technologies, finance and markets, and protect natural resources. Niger has promoted decentralization and deconcentration in order to adapt service delivery to local requirements, and many decision making processes now take place at the commune level.

Niger prepared a NAPA (National Action Plan for Adaptation) using a highly participatory process which re-enforced previous analytical work on climate risks and trends and their impact on the agriculture, forestry and livestock sectors. Adaptation measures proposed were complementary to those in the APRSP, reinforcing the importance of “climate-smart development.”

Niger is one of the countries selected to participate in the Pilot Program for Climate Resilience (PPCR)<sup>2</sup> and currently preparing its Strategic Program for Climate Resilience. It builds on existing programs and is focused on three main pillars: (i) integration of resilience into planning processes including improved weather forecasting and information, especially at local level (ii) investment support to increased resilience including improved land and water management, enhanced agricultural productivity and intensification, crop insurance and warehouse receipts systems and social protection (iii) knowledge and coordination. Niger is likely to request a total financing envelope from the PPCR of US\$ 110 m.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

Niger is thus a country where agricultural productivity, food security and climate change are at the heart of development; the following paragraphs outline some programs under way.

**Niger supports productivity enhancement through supporting intensification, and through enhancing access to technology, value chains and financial services.** The ongoing Agri-Sylvo-Pastoral Exports and Markets program (US\$ 43 million) has these aims; it supports improved access to finance and matching grants for producer organizations and cooperatives in cereal, horticulture and livestock production and processing, irrigation rehabilitation and seed production. It also supports development of mechanisms such as warehouse receipts, leasing of farm equipment and input credit. The PPCR could enhance this program with IFC support to inventory guarantees and risk management.

**Irrigation rehabilitation and development, together with support to local institutions to ensure sustainability, is a second pillar in Niger’s agriculture, food security and “climate smart” development strategy.** A key element in irrigation development is the Kandadji scheme on the Niger, whose long term objective is construction of a barrage which would permit irrigation of an additional area of up to 122,000 ha, together with many other benefits including hydro-electric power generation. . The AfDB is a principle partner for Kandadji and is presently supporting irrigation rehabilitation together with ecosystem restoration (including water hyacinth control, reforestation and river bank restoration) in the Niger valley. Through

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<sup>2</sup> The PPCR is one of the Climate Investment Funds being rolled out in a number of countries. The PPCR aims to support programs which integrate climate risks and resilience into development planning, together with other activities. The PPCR is being implemented in nine countries and two sub-regions, with a total funding envelope of about US\$ 930 million. For Niger the program is country led, and supported by AfDB, IDA and IFC together with other development partners.

river regulation the program would reduce vulnerability to climate risk for a broader population. This program could also be supported by PPCR.

**Support to local development planning is a third pillar.** Niger's Community Action Program has been under way since 2003: it supports capacity building at local level to deliver local development plans covering both social services and income generating activities, together with integrated management of community ecosystems. IDA support to date has totaled US\$ 75 million, with GEF funding of US\$ 5 million focusing on sustainable land management, and an innovative afforestation program supported by the biocarbon financed partly by IDA and partly through payments for carbon sequestration (US\$ 2.8 million for 0.82 million tons of CO<sub>2</sub> estimated to be sequestered by 2018). This program supports Niger's broad strategy for scaling up planting of *acacia senegalensis* (gum Arabic), a tree which can be interplanted with crops such as groundnuts and cowpea, is nitrogen fixing and helps to stabilize dunes. The PPCR program aims to build on the local mechanisms of this program to scale up interventions on sustainable land and water management, social protection and climate risk management.

**Emergency support remains key for Niger.** Niger's particular vulnerabilities, human development indicators and history of political difficulties mean that emergency support must remain part of any government program. The GFRP (Global Food Crisis response Program) is assisting with the present crisis.

## Kenya Country Note: Agriculture, Food Security and Climate Change

### Agriculture and its Role in the Economy

Kenya has a total area of 569,140 sq. km, and 47.4 percent of it is agricultural land, 9.1 percent of which is considered arable. The land stretches from the sea level in the east to 5,199m above sea level at the peak of Mt. Kenya, with the altitude changing gradually from the coastal belt and plains to the highlands. This topographical variation makes for variety in its agricultural production. Its main agricultural crops include tea, coffee, horticultural products, pyrethrum, pineapple, sisal, tobacco and cotton. Food crops include maize, beans, cane sugar, wheat, rice, bananas, cassava, potatoes, sorghum, millet, etc.

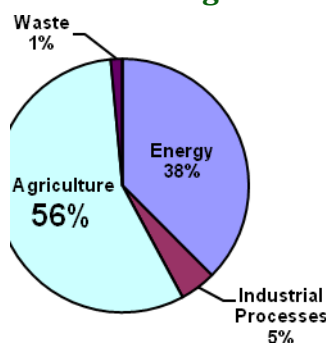
Kenya has one of the best-developed economies in eastern Africa, with a relatively advanced agricultural and industrial sectors and substantial foreign exchange earnings from agricultural exports and tourism. Agriculture remains the backbone of the Kenyan economy. It is the single most important sector in the economy, contributing approximately 27 percent of the GDP. Over 78 percent of the Kenyan population live in the rural areas and derive their livelihoods, directly or indirectly from agriculture; vulnerable groups like pastoralists, the landless, and subsistence farmers, depend on agriculture as their main source of livelihoods.

### Climate Change Projections

A study by the Stockholm Environment Institute along with DFID<sup>10</sup> has considered projections of future climate change from a suite of downscaled global models for Kenya, such as:

- **Temperature.** The projections indicate future increases in mean annual temperature (average monthly temperatures) of broadly 1 to 3.5 °C over the range of models by the 2050s (2046 -2065). There will also be increases in sea level.
- **Rainfall.** The changes in precipitation are more uncertain. All the climate models show that rainfall regimes will change but these vary with season and region. Most models project rainfall will increase on average, though some models project rainfall reductions in some months for some areas.
- **Extreme events.** The information on extreme events (floods and droughts) is much more variable and future projections vary widely. Many models indicate an intensification of heavy rainfall in the wet seasons, particularly in some regions and thus greater flood risks. Droughts are likely to continue but the projections are more varied - some models project an intensification of these events, particularly in some regions, though other models indicate reductions in severity.

### Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions



GHG emissions by sector (without LUCF) for 1994

## **Government Strategies for Agriculture, Food Security and Climate Resilience**

Agricultural policy in Kenya revolves around the main goals of increasing productivity and income growth, especially for smallholders; enhanced food security and equity, emphasis on irrigation to introduce stability in agricultural output, commercialization and intensification of production especially among small scale farmers; appropriate and participatory policy formulation and environmental sustainability. The key areas of policy concern, therefore, include:

- Increasing agricultural productivity and incomes, especially for small-holder farmers (through inputs, credit, markets and trade policies at international, regional and national levels, expansion and intensification of irrigation, and strengthening institutions for service delivery).
- Emphasis on irrigation to reduce over-reliance on rain-fed agriculture in the face of limited high potential agricultural land.
- Encouraging diversification into non-traditional agricultural commodities and value addition to reduce vulnerability.
- Enhancing the food security and a reduction in the number of those suffering from hunger and hence the achievement of MDGs.
- Encouraging private-sector-led development of the sector.
- Ensuring environmental sustainability.
- Adaptation and mitigation (through early warning systems, conservation agriculture, soil and water conservation, drought tolerant crops, and water storage systems, among others)

In July 2010, Kenya officially launched its **Agricultural Sector Development Strategy (ASDS) 2012**, a strategy to guide further development of the country's agricultural sector in line with the **Comprehensive African Agricultural Development Program (CAADP)**. The ASDS was launched to replace the **Strategy for Revitalizing Agriculture (SRA)** and has the overall objective of increasing productivity and through an increase in agricultural growth of 7 percent per year over the next 5 years. The Agricultural Development Strategy was jointly developed by ten ministries and aims at improving on the living standards of Kenyans under the vision "a food-secure and prosperous nation" by positioning the agricultural sector strategically as a key driver for sustained economic growth.

The government has made efforts to promote increased agricultural productivity through reforms and support to research; reforms and support to extension; investment in agricultural development programs; management of water tours; and expansion of irrigated agriculture. Similarly, efforts to increase access to inputs (seeds, breeds, fertilizer and agro-chemical) have been made through a national seeds supply system; increasing adoption of improved seed; targeted seed subsidy to smallholder farmers; increasing adoption of improved traditional crops; managing fertilizer prices; target fertilizer subsidy; and increasing access to animal breeds.

There are several other government policies and strategies to note, such as, the **Food Security and Nutrition Policy**, which is now finalized and under implementation and the **National Climate Change Response Strategy (NCCRS)**, which has been developed and launched.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

Kenya faces increasingly severe and frequent floods and droughts, exacerbated by land degradation. Yet it has developed regionally adapted approaches to addressing climate risks. The World Bank supports several projects that in different ways contribute to increasing Kenya's capacity to adapt to the impacts of climate variability and change. These projects focus on various sectors, such as agriculture, environment, and natural resource management. Some of the climate-related activities foster synergies between mitigation and adaptation, in particular the carbon finance operations. Experience from these programs should help Kenya, in the longer run, take advantage of carbon finance in its landscape restoration programs. Kenya is now beginning to move towards tackling protection of its mountain "water towers" through landscape restoration there.

The **Arid Lands Resource Management Project** now approaching its third phase, helps agro-pastoralists in the north and north-east manage risk posed by drought and other factors through a mix of community driven technical and social interventions, including innovative early warning systems and drought contingency funds, and strengthening and institutionalizing natural resources and drought management systems. This is reducing the vulnerability of the population in an area that experiences frequent, acute food insecurity related to drought. Additional financing approved in 2006 for the **Arid Lands Project** raised the total project credit from US\$60 million to US\$120 million. The additional financing expands the work of the Bank in the arid lands area from about 1 million people in 22 districts to an additional 1 million people in an additional 6 districts. The financing also attempts to create alternative livelihood opportunities so that the population in these areas, who otherwise largely depend on livestock, is not so vulnerable when the rains fail.

In Western and South-western Kenya flood management, watershed management and natural resources programs all aim to improve landscape management, productivity and resiliency with strong community participation:

The **Natural Resource Management Project**: The US \$68.5 million project will be used to help Kenyans better manage water and forest resources, and improve the livelihoods of surrounding communities. Communities organized in Water Resource User Associations and Community Forest Associations will benefit from funding to improve catchment management and efficient water use. As an alternative to forestry, communities will also receive support for asset building and income generating micro-projects which encourage the sustainable use of the natural resources. About 1,000 communities will receive this assistance which will generate benefits for over 2 million people. The project will target communities in the critical Upper Tana catchment and key ecosystems in the Nzoia and Yala river basins, linking with the Western Kenya project. It will also strengthen key national institutions to manage water and forest resources in a sustainable and participatory way. Most of the project's activities contribute to increased climate resilience through capacity building and sound management of natural resources.

The **Western Kenya Community Driven Development and Flood Mitigation Project**: The US\$86 million project aims to create new opportunities for the local communities in Western Kenya to engage in wealth creating livelihood activities and reduce their vulnerability to flooding. The project supports an early warning system for flood mitigation as well as improved floodplain management for major rivers in Western Kenya. Although Western

Kenya is rich in natural resources, the local communities remain poor and vulnerable to flooding, disease and natural resource degradation. The project will provide technical support and funding for demand-driven, income generating micro projects in 600 communities, including 200 projects earmarked for youth groups in Western Kenya Province, Siaya and Bondo. There is also funding for the fight against malaria. Over one million community members will directly benefit from Community Driven Development (CDD) activities.

The **Western Kenya Integrated Ecosystem Management Project** seeks to improve the productivity and sustainability of land use systems in selected watersheds in the Nzoia, Yala, and Nyando River basins through adoption of an integrated ecosystem management approach. It supports on- and off-farm conservation strategies and develops capacity in local communities and institutions to identify, formulate, and implement integrated ecosystem management activities (including both on-and off-farm land use planning), capturing local and global environmental benefits.

With the help of the **Biocarbon Fund** Kenya is piloting soil carbon sequestration based on the adoption of sustainable agricultural land management practices by smallholder farmers as well as in reforestation through the Kenya Green Belt Movement project:

The **Kenya Agricultural Carbon Project**: The overall goal of this Carbon Finance project is carbon sequestration through the adoption of sustainable agricultural land management (SALM) practices in Western Kenya. While increased productivity and improved climate-resilience of agricultural systems are the main drivers for the adoption of SALM practices, payments for GHG mitigation are considered as an additional trigger. A key component of this project is the development and application of innovative methodological approaches for measuring the amount of carbon sequestered in the soil through different agricultural land management practices. The project has developed a robust and cost effective carbon accounting methodology outlining how to quantify these emission reductions.

There are also a number of projects aimed at improving agricultural productivity. These projects, by addressing land degradation, also deal with vulnerability to future climate shocks. Furthermore, by addressing smallholder farmer incomes, they also deal with improving access to food (food security):

The **Kenya Agricultural Productivity and Agribusiness Project's** development objective is to increase agricultural productivity and incomes of participating smallholder farmers in the project area. Project activities will contribute to these objectives by transforming and improving the performance of agricultural technology systems, empowering stakeholders, and promoting the development of agribusiness in the project area. The Project has four components: (i) policy/institutional and project implementation; (ii) agricultural research systems; (iii) agricultural extension and farmer and other stakeholder empowerment; and, (iv) agribusiness and market development. The US\$82 million credit approved by the Board in June 2009 will consolidate and scale up the gains achieved in research, extension and small scale farmer empowerment during the implementation of the Kenya Agricultural Productivity Project that closed in December 2008. The **Agricultural Productivity and Sustainable Land Management** component of this project aims at assisting agricultural producers to adopt environmentally-sound land management practices without sacrificing their economic welfare. It particularly focuses on strengthening the capacity of agricultural producers to

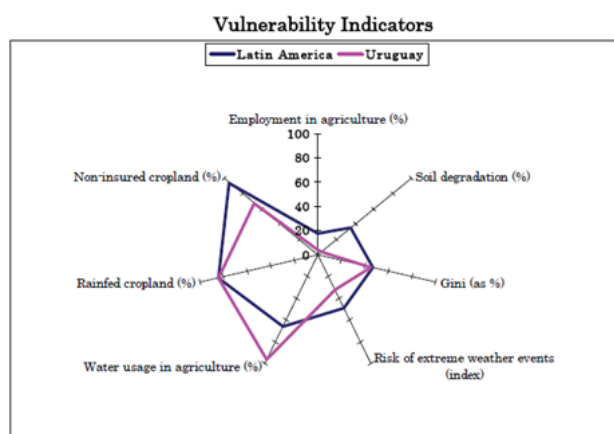
adopt sustainable land management practices and technologies to mitigate land degradation and achieve greater productivity of crops, trees, and livestock. It also assists agricultural producers to adopt alternative livelihood options where non-degrading production methods are not feasible to reduce the pressure on natural resources.



## Uruguay Country Note: Agriculture, Food Security and Climate Change

Agriculture (including land use change and forestry) is the largest contributor to GHG emissions in the country and it is also one of the most important sectors in the economy, representing 65 percent of the country's export sources.<sup>11</sup> But significant steps have been made in reforestation and carbon sequestration in the country, reducing the net effect of the sector on total GHG emissions.

Uruguay's carbon dioxide emissions per capita in 2004 stand at 1.6tCO<sub>2</sub>/capita, compared to the Latin America region of 2.6tCO<sub>2</sub>/capita and the world at 4.5tCO<sub>2</sub>/capita.<sup>12</sup> Reducing vulnerability to climate change and, in particular, to variations in precipitation is of increasing importance in the agricultural sector, coupled with more sustainable land management practices and production decisions.



Note: Employment in agriculture (% of total employment)\*; Non-irrigated cropland (% of total cropland)\*; Gini\*; Water usage in agriculture (% of total annual freshwater withdrawals)\*; Insured cultivated land area (% of total cultivated land area)\*\*; Soil degradation (% of total land)\*\*\*; Risk of extreme weather events (index; annual average 1997-2006)\*\*\*\*  
Sources: \*World Development Indicators 2007, 2000-2007 average; \*\*IADB, IICA, 2002/2003 figures; \*\*\*FAO AGL 2005; \*\*\*\*Germanwatch

### Agriculture and its Role in the Economy

Uruguay has a population of 3,334,052, and some 85 percent of the land suitable for agricultural production, one of the highest in the world.<sup>13</sup> In 1998, the total value of agricultural exports was \$1.49 billion, and over 60 percent of the agricultural export market was within Latin America, indicating that Uruguay has a strong role to play in regional food security. However, in 1998, the nation also imported \$458.2 million in agricultural goods.

Despite the importance of agriculture in the economy, a very small percentage of this population is employed in agriculture, only 4.6 percent in 2006.<sup>14</sup> The reason for this is the steady decline of family operated farms and the growing proportion of larger commercial farms.

### Climate Change Projections

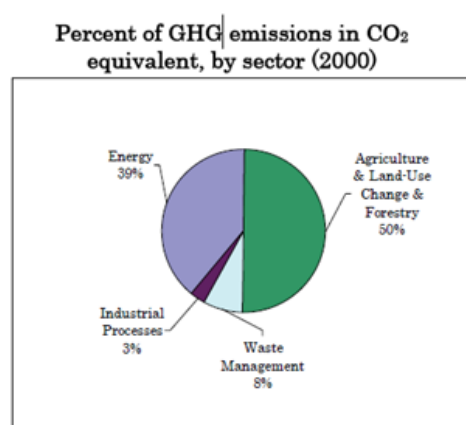
Based on climate scenarios developed by national researchers for the future 50 years, the following climatic changes with relevance to the agricultural sector can be expected for Uruguay<sup>15</sup>:

- increases in temperature – it is probable that the temperature will increase by 0.3-0.5 C by 2020, by 1- 2.5 C by 2050 and by 3.4 C by 2100;
- increase in precipitation – the amount of rainfall will increase and precipitations will reach 112mm/month (12 percent increase) by 2020 and 157 mm/month (57 percent increase) by 2100;
- rising sea levels – the climate scenarios predict a rising sea level of 5-10cm by 2020, 12-20cm by 2050 and 40-65cm by 2100;
- increased frequency and intensity of extreme weather events – rainfalls, intense winds, storms, and intense hail storms will all increase in number and intensity. Fewer days

with frost and less severe frosts will be registered which could lead to a higher incidence of pests and diseases.<sup>16</sup>

Climate change scenarios for Uruguay using general circulation models (GCM) available during 1990 predict yield reductions of 14 percent and 25 percent in maize at mean temperature increases of 2 C and 4 C, respectively.<sup>17</sup> According to a study on the future impact of climate change on agriculture in Uruguay<sup>18</sup>, using General Circulation Models (GCMs) for the years 2020, 2060 and 2100, the land productivity measured in US dollars per hectare could fall to a level of 62 percent below the current level in the case of commercial farms and to 54 percent below the current level for small family owned farms by 2020 due to weather related events. Furthermore, this study determined that future temperature and precipitation increases will have a direct positive effect on land productivity for commercial and family owned farms only up to a certain level after which further temperature increases will generate an increasingly negative effect on land productivity, particularly during the summer season. Precipitation increases seem to produce a less pronounced effect than temperature increases.

### Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions



Source: World Resources Institute <http://cait.wri.org>

The percent of greenhouse gas emissions in CO<sub>2</sub> equivalent in 2000 is presented in the diagram. Agriculture and land-use change/forestry contribute 50 percent of the total GHG emissions.

Of the total methane (CH<sub>4</sub>) emissions for the year 2000, more than 92 percent were generated from enteric fermentation from livestock. Methane emissions differ by animal type as well. Cattles account for 88 percent of the total and sheep for 11 percent.<sup>19</sup> Regarding N<sub>2</sub>O emissions, more than 66 percent of these resulted from grazing animal manure, while as part of the rest were from indirect N<sub>2</sub>O emissions generated by volatilization of this manure.

### Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security

Uruguay has made two updates to its National GHG Inventory, covering the period 1990-2000, with a third one being in the works, covering a period up to 2002. The inventory includes data on emissions from agriculture, land use change and forestry, providing disaggregated data by type of emission and type of agricultural resource.

According to the Second National Communication, agriculture combined with land-use change and forestry account for 50.2 percent of GHG emissions in the country in 2000, a large portion of this being the emissions of methane from enteric fermentation from farm animals (91 percent of the total CH<sub>4</sub> emissions). Rice cultivation accounted for 4 to 6 percent of the total methane emission from the agricultural sector in 1998.<sup>20</sup> Furthermore, agriculture is responsible for 99 percent of the total nitrous oxide emissions (mostly from animal manure), 3.6 percent of total nitrogen oxides emissions (mostly from burning of agricultural waste) and 7 percent of total carbon monoxide emissions (mostly from burning of agricultural

waste). Carbon dioxide emissions for the period 1990-1994 represented more than 80 percent of all gases emitted in Uruguay while as at present Uruguay registers carbon dioxide absorption.

Based on future climate change scenarios, the fishery sector will suffer a direct economic impact through an alteration in the composition of fishery resources, a reduction in catches and an increase mortality rate in some basin areas.

The total forested area in Uruguay represents close to 8 percent of the total land area. Due to the country's good climatic conditions for growing of forests, there is great potential for future forestation. Since the adoption of the Forestry Law in 1987, Uruguay has undertaken a sustainable development of forested areas which lead to the planting of around 600,000 ha of new forest areas between 1990 and 2000. As a result of this, forest plantation areas increased from about 200km<sup>2</sup> in 1987 to over 6599km<sup>2</sup> in 2000 (33 times) and the cumulative net carbon sequestration during the period 1988-2000 was estimated at 27.4 MtCO<sub>2</sub>. The average annual deforestation rate stands at negative 5 percent.

### **Government Strategies for Agriculture, Food Security and Climate Resilience**

The **Program of General Measures on Mitigation and Adaptation to Climate Change** (PMEGEMA), was prepared by the Climate Change Unit in February 2004 through the inter-sectoral and interdisciplinary collaboration of various Working Groups comprising professionals from various ministries, private sector and NGOs. The Program proposes a set of mitigation and adaptation response measures to climate change to be applied to the most relevant sectors of the economy, including agriculture, forestry, water resources, fisheries and biodiversity. One of the policies that Uruguay has undertaken with future climate change benefits was the passing in 1982 of the Soil Management Law that encouraged the use of soil conservation techniques which resulted in the sequestration of 1.8 million ton carbon per year over the last 20 years.<sup>21</sup>

The **National Program for Voluntary Net GHG Emission Abatement** (PRONAVEN) is an important inter-institutional instrument aimed at improving understanding and consideration of climate change issues at national and sectoral levels, as well as achieving the actual implementation of mitigation and adaptation options detailed in the PMEHEMA.

The **Project of Self Assessment of the National Capacity to Meet International Environmental Obligations for Improved Global Environmental Management** (AECN) provides an assessment of the country's capacity to meet in an integrated manner the commitments delineated under international environmental conventions on climate change, biodiversity and to combat desertification and droughts. The document does not make direct reference to the agricultural sector.

### **Agriculture Sector Initiatives**

The **Ministry of Livestock, Agriculture and Fisheries** (MGAP) is responsible for formulating policies related to the protection of the agricultural sector and fisheries. It counts with a **Forestry and Agricultural Climate Change Projects Unit** (UPACC) whose mission is to identify, evaluate and promote opportunities for mitigation and adaptation projects in the agricultural sector, including forestry. It also initiates forestry and agricultural projects for Uruguay within the Clean Development Mechanism market.

The **National Institute for Agricultural Research (INIA)** counts with an **Agro-climate and Information Systems Unit (GRAS)** that has as main objective the promotion, coordination and execution of research projects and other activities related to climate change and its impact on agriculture and forestry. One of its more recent projects looks at the possible impacts of climate change on natural pastures and rice production in Uruguay as well as possible adaptation measures in this area.

Uruguay has a long history of **agricultural insurance**. The government of Uruguay has 5 main instruments (programs) in place that directly support the agriculture sector in managing climate risks. All of these instruments require public sector budgetary resources to operate:

- Banco de Seguros del Estado: public insurance company which offers subsidies insurance policies as per the agreement signed with the Ministry of Agriculture (MGAP).
- Ministry of Agriculture (MGAP): it administers the premium subsidy for agricultural insurances channeled through BSE as well as the fund for reconstruction of small producers.
- Vineyard Integral Protection Fund: it is managed by the National Viticulture Institute (INAVI) and producers get paid only when damages exceed 30 percent of production.
- Fund for the Reconstruction of Small Producers: it was established to provide catastrophic coverage to small farmers affected by a large climate event in 2002 (hail and drought). This fund provided immediate indemnities to small farmers but also established a contingency fund and a premium subsidy for agricultural insurance for small farmers.
- Climate Contingency Emergency Fund: it has been created to cover excess losses for producers that already have insurance. Since insurance contracts usually have a stop loss, this public fund covers the rest of the value of production lost, which is not covered by the insurance policy.

Two changes with positive results in **carbon sequestration** occurred in Uruguay in the forestry sector: The introduction of no-tillage practices in areas with annual crops (15 percent of total area with annual crops in 2000) and the increase of areas with artificial grasslands during the period 1980-2000. These two practices led to an annual CO<sub>2</sub> absorption of 3,300 kton. Furthermore, the total national emissions of CO<sub>2</sub> for the period 1990-2000 decreased by 28 percent as a result of the CO<sub>2</sub> absorption generated by tree biomass. Uruguayan forestry policy has also included prohibition of harvesting of native forests. This resulted in an increase in native forest area from 667,000 ha in 1970 to 810,000 ha in 2004.<sup>22</sup>

One of the **mitigation measures** identified in the PMEGEMA with the final aim of reducing CH<sub>4</sub> emissions is to improve livestock diet by increasing the sown pastureland where animals graze (estimated abatement of 24 MtCO<sub>2</sub>e for the future 20 years). The PMEGEMA defines the various **adaptation measures** in the land use sector. Some examples are: improving the seed bank with genetic material that would allow the preservation or increase of current crop yields when faced with future temperature increases combined with excess and deficit of humidity; promoting the sustainable management of soil, including no-tillage and other conservation methods; monitoring of pests and diseases; improving the efficiency in fertilizer use and direct sowing as this results in less soil erosion; monitoring of oceanographic variables, breeding areas, distribution, catching ability and abundance of fishery resources and verification of algal bloom episodes; implementing measures to avoid the dumping of residual waters in the coastal areas.

## Programs to Support Climate-Smart Agriculture: Successes and Challenges

The Bank has contributed to the Government's overarching goal of sustaining growth through a number of interventions in various sectors. In the agriculture sector, the Bank has assisted the authorities with progress in animal health. Beef exports were severely affected in 2001 by the outbreak of foot and mouth disease and subsequent closure of several export markets. The Bank provided financing for reducing the risk of recurrence of the disease and improving animal health. In addition, the Bank-financed **Natural Resources Management Project** is helping small and medium size farmers to switch to more environmentally friendly production techniques.

The **Integrated Natural Resources and Biodiversity Management Project** (2005 to 2011) has a budget of US\$30 million and aims to promote, particularly among groups of small and medium-sized farmers, the adoption of economically and environmentally viable integrated production systems, within a context of holistic ecosystem and natural resources management, while mainstreaming biodiversity. The global environment component of the project seeks to promote increased understanding on the role of biodiversity in agricultural landscapes, and the potential impact of various land use practices upon biodiversity, and their economic and ecological sustainability.

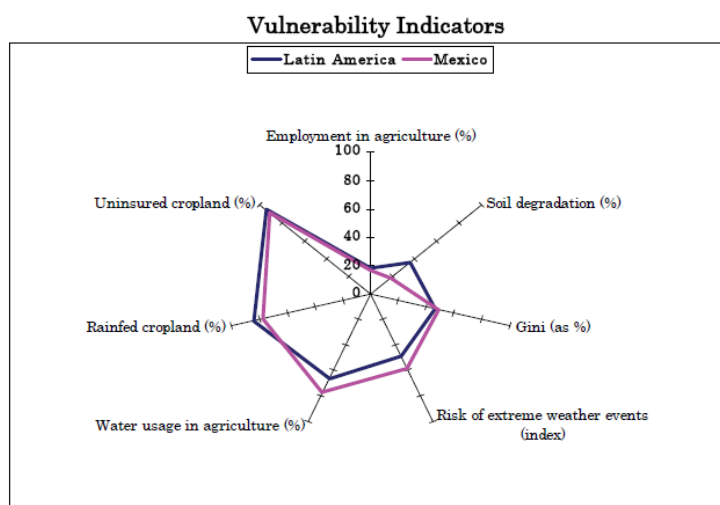
The Project's overall objective is addressed through the provision of technical and financial assistance to farmers to develop and implement appropriate technologies to increase the productivity of agricultural and livestock systems while: ensuring biodiversity conservation; promoting the adoption of cultural practices to conserve soils; reducing the impact of grazing; reducing the risk of erosion and enhancing the efficient use of water resources; understanding the carbon sequestration potential of various land-use practices; and delineating a strategy to promote carbon sequestration in Uruguay's productive landscapes.

The main project instrument is the implementation of demand-driven subprojects that are complemented by a series of supporting activities such as: technical assistance; training aimed at raising awareness of natural resources and biodiversity conservation; management in the productive sectors; and building institutional and landowners' capacity for holistic management of natural resources that integrates biodiversity conservation into productive landscapes.

Through the *natural resources and biodiversity management* component of the project, demand-driven activities are financed to promote sustainable management of natural resources and biodiversity, through financial and technical assistance towards improving natural resources management practices in livestock production systems, with special reference to improved management of natural pastures and biodiversity. It promotes improved practices in dry land agriculture, for natural resources management systems in irrigated areas and, in biodiversity conservation. Another component of the project aims to establish demonstration areas for a sustainable use of natural resources in key micro-catchments which are of importance for biodiversity, combining sound practices for natural resources management, and creating increased public awareness on the significance, and socioeconomic importance of biodiversity.

## Mexico Country Note: Agriculture, Food Security and Climate Change

Agriculture accounts for 4 percent of Mexico's GDP and 15 percent of employment. The Agricultural Sector Program 2007-2012 points out that more than half of the value of the total agricultural production of Mexico (54 percent) is generated in 8 States. But the agricultural landscapes play a key role in watershed protection and broader ecosystems conservation, and include highly varied production systems. 23 percent of cropland is irrigated and the sector accounts for 77 percent of water use. Agriculture and land use changes together account for about 21 percent of GHG emissions. 23 percent of land area is forested but deforestation has played a major role in GHG emissions over the last 20 years.



Note: Employment in agriculture (% of total employment)\*; Rainfed cropland (% of total cropland)\*; Gini\*; Water usage in agriculture (% of total annual freshwater withdrawals)\*; Uninsured cropland (% of total cultivated land area)\*; Soil degradation (% of total land)\*\*; Risk of extreme weather events (index; annual average 1997-2006)\*\*\*\*

Sources: \*World Development Indicators 2007, 2000-2007 average; \*\*LADB, IICA, 2002/2003 figures; \*\*\*FAO AGL 2005; \*\*\*\*Germanwatch

Small agricultural producers are particularly vulnerable to climatic changes, as they depend on rainfed agriculture, and have limited financial resources to spread risk.

### Agriculture and its Role in the Economy

Agriculture contributes 11 percent of total GHG emissions of Mexico, and with land-use change and forestry, it is another 14 percent or so. The emission reduction potential in the sector is primarily focused on methane reduction, though more diversified carbon trading opportunities can be pursued. Agriculture is highly vulnerable to weather extremes, in particular in the Northern parts of the country, where water scarcity is an issue, or the Southern parts of the country, where tropical storms cause extensive damage to crop and livestock production. Reducing vulnerability to climate change is of utmost importance in the agricultural sector in Mexico, considering the role the sector plays in food security and livelihoods of rural populations.

### Climate Change Projections

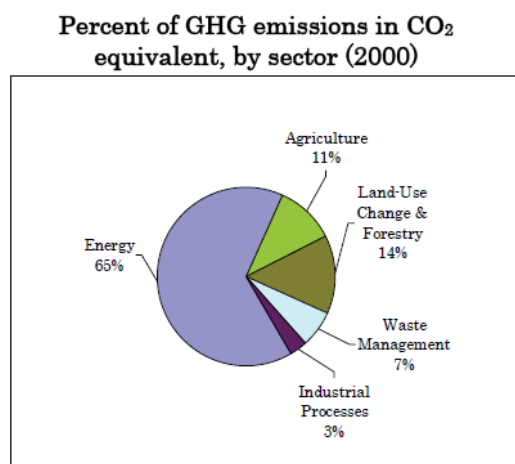
According to the Third National Communication the following climatic changes with relevance to the agricultural sector can be expected in Mexico:

- increases in temperature - by 2020 projected temperature increases in the winter are between 0 and 2.5 C and in the summer are in the range of 0.9 and 2.2 C.<sup>23</sup> It is probable that by the year 2050 the climate in Mexico will become warmer by 2 to 4 C.
- reduction in precipitation - the rainfall will decrease by up to 15 percent in the Central part and by less than 5 percent in the area of the Gulf of Mexico, mainly between January and May; by 2020 projected precipitation fluctuations will be in the range of -7 to +12 percent (December-February) and -8 to +12 percent (June-August).<sup>24</sup>
- increased frequency and intensity of extreme weather events - the number of severe storms and the intensity of periods of severe drought will also increase; the sea water



temperature will increase between 1 and 2 C leading to stronger and more intense tropical hurricanes in the Caribbean Sea, the Gulf of Mexico and the Mexican portion of the Pacific Ocean, with an increase of 6 percent in wind intensity and an increase in precipitation of 16 percent within a radius of 100km from the center of the hurricane; the cold fronts may become less frequent.

## Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions



Source: World Resources Institute <http://cait.wri.org>

According to the Strategy (ENACC, 2007), **agriculture** accounts for 7 percent of total GHG emissions in the country and forests and land-use change account for 14 percent, a total of 21 percent of emissions.

Only 13 percent of the land area in Mexico is used for agricultural activities, 55 percent for summer pasture and grazing and 23 percent for forestry related activities. Mexico is responsible for 14.8 percent of all Latin American consumption of fertilizers (1,711 Mt/year). Fertilizers used in agriculture contribute 16 percent of total emissions of CO<sub>2</sub>Gg tones yearly. According to the Climate Change Inter-ministerial Commission (CICC, 2007), in Mexico CO<sub>2</sub> emissions resulting from activities related to the change in the use of soil and agriculture amounted approximately to 135 million tons of CO<sub>2</sub>e in 2002, accounting for 21 percent of total emissions in Mexico. The emissions of other greenhouse gases, like methane and nitrous oxide, have decreased by 2.7 percent in the period 1990-2002 (CICC, 2007).

The scale of **deforestation** in Mexico in the last 15 years has been large with 47.8 thousand sq km of forest area change from 1990 to 2005. The average annual deforestation rate between 1990 and 2005 is 0.5 percent.<sup>25</sup> For each hectare of forest lost in Mexico, between 20 and 170 tons of carbon were emitted into the atmosphere, depending on the type of forest.<sup>26</sup> The total GHGs for 2002 were estimated at 86,877Gg in CO<sub>2</sub>e of which emissions from combustion and decomposition of biomass associated with converting forests to other uses account for 74 percent (64,484 Gg in CO<sub>2</sub>e units).

**Livestock** are an important source of methane (CH<sub>4</sub>) emissions. Of the total methane emissions from livestock in Mexico for the period 1990-2002 89 percent came from beef and beef-dairy production, 10 percent from dairy cattle and 1 percent from other livestock.<sup>27</sup> These emissions represent 88 percent of total livestock related emissions, the remaining 12 percent being nitrous oxide (N<sub>2</sub>O).

Mexico has made 3 updates to its National GHG Inventory<sup>28</sup>, covering the period between 1990 and 2002 and a user-friendly, searchable database is available to the public.<sup>29</sup> In per capita terms, in 2005 Mexico was the 2nd largest emitter of CO<sub>2</sub> in LAC (at 3.70 t CO<sub>2</sub>/capita). Though the level of GHG emissions has grown as the economy develops, the carbon intensity of the Mexican economy has decreased by 5 percent since 1993. The emissions reduction potential of agriculture and forestry is small, estimated at 10 percent and

4 percent, respectively (as compared to other sectors). The emission reduction potential associated with each measure of the ENACC is an estimate of the maximum achievable levels by 2012.

### **Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security**

During the past two decades, over 80 percent of the total economic losses from weather-related disasters occurred in the agricultural sector.<sup>30</sup> The drought of 1997-1998, for example, produced a record number of forest fires; a period of drought during the 1990's resulted in many water-related conflicts in the North of the country; delays in the rains in 2005 resulted in the reduction of agricultural production by 13 percent.<sup>31</sup>

Significant changes are expected in covered areas for both forests and grasslands - changes to the order of 67 percent of temperate forests in Mexico are foreseen due to drier and warmer conditions. It is anticipated that climate change will result in an increase in scale and frequency of fires because climatic conditions will favor initiation and propagation of forest fires, replacement of tropical forests by savannas in Central and Southern Mexico along with replacement of semi-arid by arid vegetation in most of Central and Northern Mexico and extinction of species found in tropical forests. A reduction in agricultural production is expected and a significant reduction in livestock production can also be produced if temperate pastures are adversely affected by droughts caused by higher temperatures.<sup>32</sup>

The most important agricultural crop cultivated in Mexico is corn (it occupies 50 percent of total cultivated area). The crop is highly susceptible to climate variability, in particular droughts. The climate scenarios for 2020 for Mexico predict a moderate reduction in the aptitude of cultivation of seasonal corn and an increase of the land not suited for cultivation of up to 4.2 percent. A further effect will be a reduction of pastureland (6 percent loss by 2020 and 13.2 percent by 2050 relative to 2002 base year) used for livestock in the Northern and Central part of the country due to increased drought and land deterioration and an increase of plagues associated with environmental changes.<sup>33</sup>

There are opportunities in the form of **adaptation measures** that could result in positive social outcomes include improved management of water availability and a shift to drought resistant crops. In addition, adaptation should ensure that communities' traditional knowledge and capacity in managing climatic changes is recognized and further strengthened. Coping strategies of poor farmers to weather variations in Mexico have included:

- diversification (short-term reactions range from selling livestock, seeking off-farm employment and informal loan options, replanting and switching to shorter-cycle crops; in the long-term, switching to subsistence maize is a prevalent strategy) - non-farm income (55 percent of rural incomes in Mexico<sup>34</sup>) and in particular non-farm wages e.g. from working in public projects, in tourism or other industries are the most profitable form of livelihood diversification;
- migration to urban areas or the USA - Mexico is the largest remittance-receiving country in the region, with over \$23 billion in 2006 (money originates from the US). Highest concentrations of recipients are in Central Mexico, in the regions of Guanajuato, Jalisco, Michoacán, San Luis Potosí, and Zacatecas<sup>35</sup>;
- storage of rainwater for additional irrigation.



## **Government Strategies for Agriculture, Food Security and Climate Resilience**

To date, Mexico is the only developing (non-Annex I) country to have submitted three National Communications to the UNFCCC<sup>36</sup>, demonstrating a strong commitment to the international climate change agenda. The communications lay out the actions that the government has already taken and the analytical basis for its policy response to climate change and its commitment to take future actions within an official international framework.

### **Agriculture Sector Initiatives**

The **Agricultural Sector Program 2007-2012** defines climate change as a strategic national and international problem which demands immediate action. The Program, which is based on an assessment of the impact of climate change in the sector, reconfirms the importance of ongoing programs targeting reconversion and rotation of crops, efficient use of fertilizers, conservation tillage, and special attention programs to farmers affected by extreme weather events. In addition, it promotes other methods, such as generating incentives to expand sustainable use and conservation of natural resources and wild lands. Mitigation activities include eliminating the use of fire, promoting zero tillage, reforestation, retrofitting livestock facilities to capture and use of methane and more efficiency in the use of energy in fisheries. The main initiatives to strengthen capacity to adapt to climate change include targeted research, gene banks and expansion of seed reserves, corridors and conservation areas.

The **National Water Program 2007-2012** (Programa Nacional Hidrico) is developed with focus on climate change policies. Among the proposed adaptation measures in the water sector are fomenting the efficient use of water in the agricultural sector, diminishing the risks of floods, promoting the technical, administrative and financial development of the water sector and the promoting integrated and sustainable water management.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

#### **The Clean Development Mechanism (CDM) and the Mexican Carbon Program (PMC)**

As of January 2009, there are 110 registered projects in Mexico, representing 28 percent of all registered projects in LAC. Mexico also holds 8.12 percent of the global share of projects. Of the registered CDM projects in Mexico, 23 are classified as being related to agriculture (or 21 percent of all registered CDM projects in the country). All the registered agricultural projects address GHG reductions from improved animal waste management systems in confined animal feeding operations in different regions of the country.

The **Mexican Carbon Program (PMC)** was established in 2005 to coordinate scientific activities related to the carbon cycle in Mexico, assisting in the design of public policy aimed at tackling and adapting to climate change. Among the participants in the Program are 27 governmental, non-governmental and academic institutions, including some from the agricultural sector.

The Government of Mexico has requested an **Adaptation to Climate Change in the Water Sector Development Policy Loan (DPL) Program** in the amount of US\$450 million to be presented to the Board for its approval by the end of Fiscal Year 2010. Mexico has emerged as a global climate change leader and is moving quickly to prepare mitigation and adaptation policies to tackle the most pressing issues that affect the country's main economic sectors and the DPL will support government priorities established in the climate change adaptation and water sector agenda.

Water used for agriculture represents around 77 percent of estimated total national water abstraction, which totals 78.9km<sup>3</sup> for the country as a whole. Of the 6.5 million hectares with irrigation facilities in Mexico, about 67 percent are irrigated with surface water (40.5 km<sup>3</sup>), and the remaining hectares are served by groundwater pumping (20.1 km<sup>3</sup>). In light of the importance of the agriculture sector in total water use, demand management and efficiency improvements in irrigation are key drivers of federal programs.

The main objective of the proposed operation is to support the government's efforts aimed at strengthening the institutional framework and monitoring capacity in integrated water resources management as well as mainstreaming adaptation to climate change in water programs. The proposed DPL supports the government's policy commitment to adaptation to climate change in the water sector, including the allocation of institutional and financial resources and strengthening of monitoring and evaluation capacity. Operations would include funding irrigation systems that reduce water usage (e.g., high- or low pressure systems, or demand-based irrigation) and implementing low water consumption agriculture (including macro-metering of surface and groundwater).

**The Mexico Climate Change Development Policy Loan Project** has a budget of US \$501.25 million and aims to support the government of Mexico's efforts to mainstream climate change considerations into public policy. The operation consists of policy reforms in three areas:

- improved analytical basis for policy responses through the submission of a third national communication to the United Nations (UN) framework convention on climate change;
- the approval of the national climate change strategy by the government's inter-secretarial commission on climate change and its announcement by the President; and
- the integration of climate change considerations in sector programs.
- This operation builds on the Bank's engagement in the energy and natural resources sectors, and ongoing support on the climate change activities in Mexico, particularly on: (a) support for adaptation; (b) policy development and institution building; (c) first-of-a-kind mitigation projects and programs; and (d) identification and promotion of short-term and long-term mitigation options.

In the context of the long-term development challenges posed by climate change, the DPL's contributions are:

- Reinforcement of a results framework for voluntary emission reductions and focus on vulnerability reduction through adaptation action plans.
- Improved institutional capacity, including coordination and knowledge base, to undertake key actions.

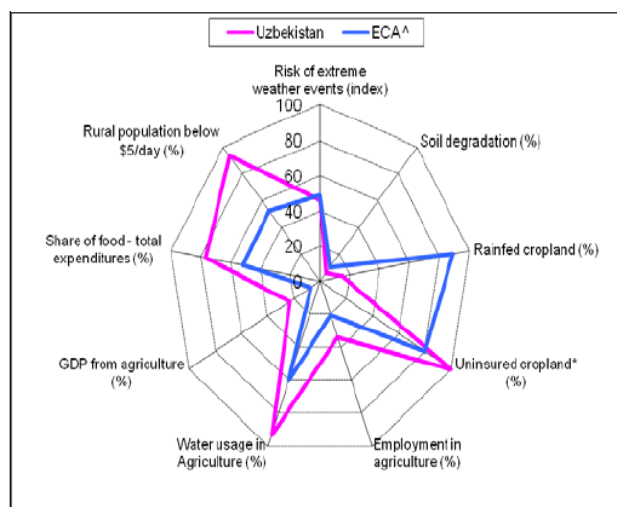
**The Sustainable Rural Development Project** (2009-2013) would be implemented over a 5 year period, and have a total cost of US\$ 168.0 million. It aims to promote the adoption of environmentally sustainable technologies in agri-businesses. The environment objective is to contribute to the goals of the National Strategy on Climate Change by reducing GHG (CO<sub>2</sub>) emissions through the adoption of emission-reduction technologies and the support to the implementation of the President's Special Program for Climate Change (PECC), with special

reference to the improved environmental sustainability of small and medium-scale agri-business.

There are four components to the project. The first component is to promote investments in environmentally sustainable technologies in agri-businesses operating at the various stages of the production chain of agricultural products. The second component is the investment and production support services to beneficiaries, financial, as well as technical assistance for implementation of their proposed business plans, and training to integrate technologies promoted through the project in their farms and agri-businesses. The third component is the institutional strengthening and financing of assistance for policy development to address issues related to climate change and the environmental impact of sub-projects, in particular, institutional strengthening of areas within Ministry of Agriculture, Livestock Production, Rural Development, Fisheries and Food (SAGARPA) that will address the targets outlined within the National Strategy on Climate Change and the President's Special Program for Climate Change (PECC). The fourth component is the project management, monitoring, and evaluation.

## Uzbekistan Country Note: Agriculture, Food Security and Climate Change

Uzbekistan is a landlocked country located in Central Asia, bordered by Kazakhstan, Turkmenistan, Afghanistan, Tajikistan and Kyrgyzstan. The population of Uzbekistan is estimated to be 26.9 million with 63 percent of the population living in rural areas.<sup>37</sup> The country has a surface area of 448.9 thousand km<sup>2</sup>, with the majority of the landscape comprised of desert plains, with approximately 20 percent of the territory consisting of mountains and foothills in eastern and north-eastern parts of the country.<sup>38</sup> About 50 percent of the territory is used for agricultural production while approximately 19 percent is covered by forests<sup>39</sup>. The water resources of Uzbekistan are primarily provided by the Syr Darya and Amu Darya rivers, and their tributaries. These rivers form part of the Aral Sea basin and are shared with other riparian countries in the region.



Note: Employment in agriculture (% of total employment)\*; Rainfed cropping (% of cropland)\*; Water usage in agriculture (% of total annual freshwater extraction)\*; Uninsured cropland (Estimate); Soil degradation (% of total land)\*\*\*; Risk of extreme weather events (additional 1:20 year events 2070-2100 Vs. 1961-1990)\*\*\*\*; Share of food – % of total expenditures \*\*\*\*\*; GDP from Agriculture\*; Rural population below \$5/day\*\*\*\*\*; Sources: \*World Development Indicators 2008; \*\* FAO AGI 2005; \*\*\* Baettig, M. et al., 2007. \*\*\*\*\* ECA Databank. ^ECA statistics come from transitions and developing economies of Eastern Europe and Central Asia, where available

Agriculture is a significant land use in Uzbekistan, with natural pastures occupying 40 percent and croplands 12 percent of the surface area of the country.<sup>40</sup> Due to the arid conditions, more than 85 percent of the cropland in the country is irrigated, with area of irrigated cropland comprising approximately 10 percent of the land area of Uzbekistan.

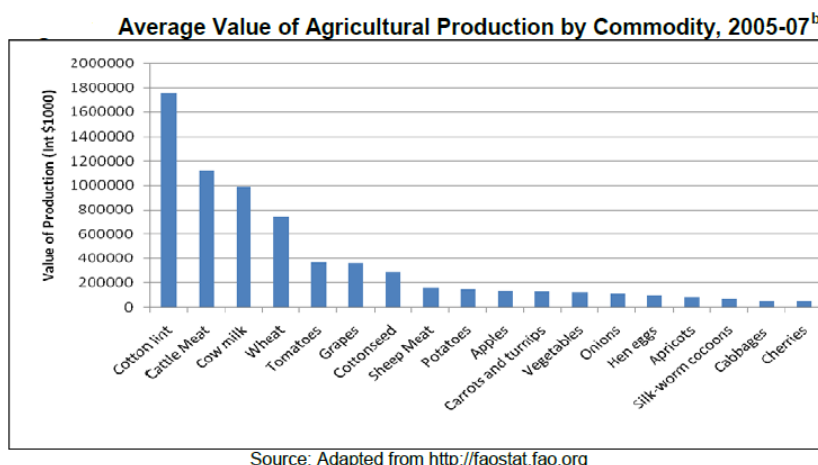
### Agriculture and its Role in the Economy

Agriculture is of vital importance to Uzbekistan, in terms of employment, rural livelihoods, food security, and exports. Approximately 34 percent of the population is employed in agriculture, 23 percent of the country's GDP, and 40 percent of the country's exports are derived from the sector.<sup>41</sup>

Agriculture has traditionally been a strong and relatively stable contributor to Uzbekistan's economy. Despite structural and non-structural changes to the agriculture sector post-independence, agricultural GDP increased marginally at an average annual rate of 0.5 percent from 1990-2000.<sup>42</sup> Post 2000, the sector has expanded strongly at a robust average annual rate of 6.8 percent from 2000-2007.<sup>43</sup>

Cotton is the primary source of exports (Uzbekistan is the world's fifth largest producer and second largest exporter of the commodity). At the commodity level, cotton lint, cattle meat, cow milk, wheat, tomatoes, grapes, and cottonseed made the most significant contribution to the average value of agricultural production in Uzbekistan from 2005-2007. Approximately 60 percent of the value of agricultural production is derived from the annual and perennial crop sectors, while the livestock sector produces the remaining 40 percent.<sup>44</sup> Although field crops like cotton and wheat are grown extensively and occupy a large percentage of the

cropping land, other crops like tomatoes, grapes, potatoes, and apples make a significant contribution to the value of agricultural production on a proportional basis, as they can garner a higher price.<sup>45</sup>



### Climate Change Projections

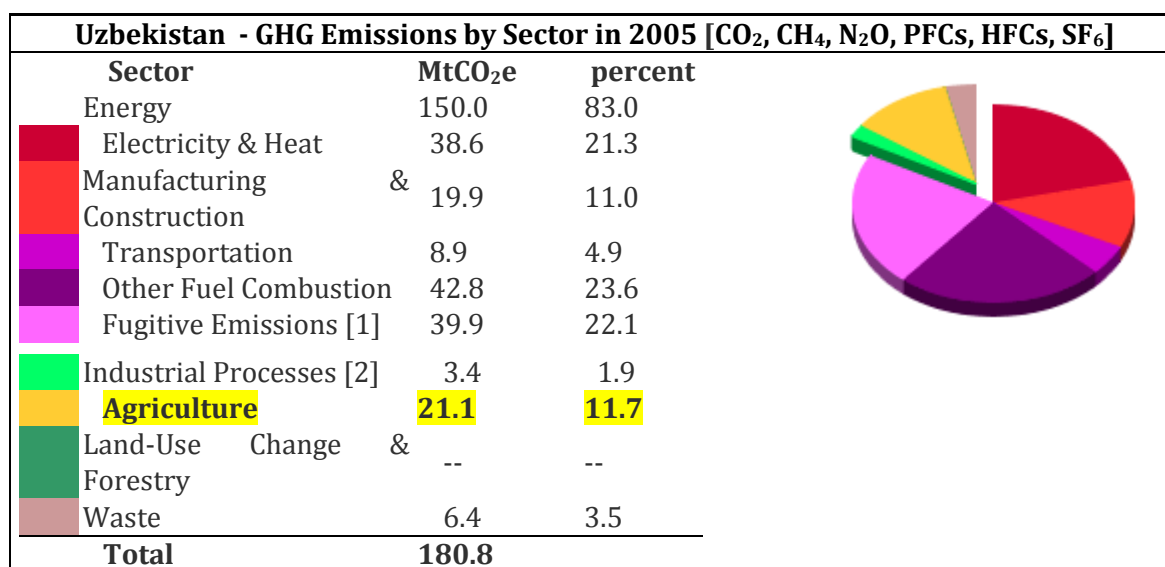
Historical data indicates that Uzbekistan is characterized by a highly variable climate that has already experienced an increase in mean temperature, extreme hot days and plant evapotranspiration (aridity).<sup>46</sup> Climate projections for the future indicate, on average that Uzbekistan will be exposed to<sup>47</sup>:

- A 1.9°C to 2.4°C increase in mean annual temperature by 2050, with regional differences, with the greatest warming projected to occur in winter and spring
- An increase in mean annual precipitation by 15-18 percent by 2050, with the greatest seasonal increase in summer
- A progressive worsening of the projected water deficit of Uzbekistan at the Aral Sea basin level, as water demand increases (especially for irrigation), whilst secured water withdrawals decline in both the Amu Darya and Syr Darya catchments, with the water deficit projected to increase over 500 percent from 2 km<sup>3</sup> in 2005 to 11-13km<sup>3</sup> in 2050.
- A more marginal and risky agricultural production environment, as increasing temperatures result in greater crop evapotranspiration, offsetting projected increases in precipitation and resulting in a more arid production environment that is more reliant on already stressed and deficient water resources.
- An increased exposure to new pests and diseases for agricultural crops and livestock due to changes in the temperature and precipitation regime.
- An increased length of growing season, especially in northern areas, providing opportunities for new crops, increased productivity and changes to cropping patterns.

### Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions

As of 2005, the agriculture sector accounted for approximately 12 percent of Uzbekistan's greenhouse gas (GHG) emissions and was second behind the energy sector, which produced the majority of the GHG emissions for the country at 83 percent.<sup>48</sup> The land-use change and forestry sector has historically been a net emitter of GHG in Uzbekistan since 1990, primarily as a result of deforestation and land-use change. However, for the most recent assessment in 2005 the sector has been a small net sink of GHG, primarily due to a sharp decline in the use of swamp land for rice cultivation.<sup>49</sup> On the other hand, agriculture has an important role to

play in the mitigation of GHG emissions, with many of the practices that have benefits for both productivity improvement and adaptation also having synergistic mitigation benefits.



### Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security

The downside risks for Uzbekistan outweigh any potential benefits that may result for the agriculture sector as a consequence of climate change.<sup>50</sup> Even for particular crops and agro-ecological zones that could benefit from climate change, Uzbekistan is poorly positioned to take full advantage of such opportunities, unless investments and structural changes are implemented in the agricultural sector to address the country's relative low productivity and associated adaptation deficit to the present climate.<sup>51</sup>

### Government Strategies for Agriculture, Food Security and Climate Resilience

The Second National Communication of Uzbekistan, published in 2008, is the primary document that assesses the impact and outlines adaptation options to respond to projected future climate hazards. The document includes climate projections for Uzbekistan to 2100 and undertakes a preliminary vulnerability assessment of sectors including agriculture, water resources, and biodiversity and ecosystems. This assessment includes an analysis of climate change impacts, as well as broad recommendations on potential adaptation and mitigation options for each sector. However, although adaptation options are identified and action plans are defined within the Second National Communication and linked background documents, limited economic analysis, evaluation and prioritization of potential adaptation options, and associated action plans has been performed, especially at higher resolution agro-ecological zone scale.

### Agriculture Sector Initiatives

The main objectives of Uzbekistan's agricultural policy in recent years have been to:

- i. maximize and stabilize export revenues from agricultural outputs;
- ii. achieve food security through self-sufficiency in wheat production; and
- iii. improve rural standards of living through promotion of rural employment and enhanced social stability

Currently the mainstreaming of climate change into the policy initiatives of the agricultural sector is still in its infancy. Climate change has been addressed to a minor extent in policy documents such as the **National Strategy of Sustainable Development** and the **Water Saving and Rational Water Use in Irrigated Land Tenure Strategy**.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

**Drainage, Irrigation and Wetlands Improvement Project** (US\$ 74million): The project aims to increase the productivity of irrigated agriculture, employment and incomes in Karakalpakstan, one of the poorest regions in Central Asia; improve the water quality of the Amu Darya River by safe disposal of the drainage effluent, and enhance the quality of wetlands in the Amu Darya delta; and develop the institutions for improving water management, operation and maintenance of the irrigation and drainage systems, and for promoting sustainable irrigated agriculture through participatory irrigation management.

**Ferghana Valley Water Resources Management Project** (US\$ 82million): The Fergana Valley has abundant surface water resources and large quantities of good-quality groundwater resources, but there is a lack of drainage facilities, and therefore the area suffers from waterlogging and soil salinization. At present, both of these constrain agricultural production; degrade the environment, and damage housing and public infrastructure. Soil degradation, low water-use efficiency, over-irrigation, weak infrastructure and institutions, and a lack of farmers' incentives are the main factors impeding the productivity and sustainability of irrigated agriculture in the project area, and tend to reinforce each other. Thus, the objective of the First Phase of the Ferghana Valley Water Resources Management Project for Uzbekistan is to improve agricultural production in areas affected by water-logging, and to reduce damage to housing and infrastructure from rising ground water levels and salinity in the project districts. There are three components to the project. The first component of the project is improvement of irrigation and drainage network. This component aims at addressing the problem of high groundwater levels by financing for improvements in surface irrigation and drainage network as well as for installation of subsurface horizontal and vertical drainage wells. The second component of the project is institutional strengthening and agricultural development support. This component will finance institutional strengthening support to public institutions and private farmers (water users) organizations involved in water management and utilization. The support includes supply of operation and maintenance, laboratory, Information Technology and office equipment as well as training and study tours. The third component of the project is project management, monitoring and evaluation of project impact. The component will support strengthening the Ministry of Agriculture and Water Resources and project implementation unit capacity for project management, monitoring and evaluation through the provision of goods, consultant services, including project audit, and training, and financing of operating costs.

**Rural Enterprise Support Project** (Second Phase: US\$ 75million; First phase US\$ 43million): This project aims to address a key issue facing the agricultural sector in Uzbekistan, which is the lack of farmers' incentives to improve production and productivity, as a result of the public sector dictating the somewhat monopolistic input supply, agro-processing, and marketing systems, which deprive farmers of choice, raise the cost of their purchases, and lower the price of their sales. Thus, the objective of the Second Phase Rural Enterprise Support Project for Uzbekistan is to increase the productivity and financial and environmental sustainability of agriculture and the profitability of agribusiness in the project



area. The rural enterprise finance component aims to enhance access to commercial financial services and reduce the risks associated with lending to the agriculture sector. The irrigation and drainage component aims to improve water management of irrigated areas through investments in the rehabilitation of irrigation and drainage infrastructure, strengthening Water User Associations (WUAs) and investments in demonstration plots for applied modern irrigation techniques. The rural training and advisory services component provides training and advisory services to newly independent farmers in various farm management skills and increases availability of technical information and advisory services.

The potential beneficiaries under this project (a rural population of about 400,000 people living on 162,000 hectares of irrigated land and the people providing goods and services to farms in the area) would have increased incomes through greater crop yields, lower costs of production, value-added from processing, and access to markets and credit sources. Resulting improvements in farm productivity and profitability would set the stage for growth in the rural economy, and in the national economy at large. Elimination of state intervention in production and marketing and the transfer of land and water rights to private operators would provide the foundation for environmentally sustainable and profitable agriculture. The initiation of transparent rural financial services would introduce farmers to commercial finance and intermediation, and to financial responsibility. By acquiring significant freedoms in decision-making and economic activities, restructured farm units would become a catalyst for the development of a variety of complementary production services, value-added processing and marketing functions, and a broad array of agribusinesses likely to generate rural employment.

**Europe and Central Asia Regional Program on Reducing Vulnerability to Climate Change in Agricultural Systems:** Uzbekistan is one of four countries participating in this three year program of analytical and advisory activities, designed to better determine the potential impacts of climate change on the agricultural sector. Work is being carried out with key stakeholders to develop practical recommendations on the actions these countries can take to increase the resiliency of their agricultural sectors in the face of climate change. The overall objective of this program is to enhance the ability of countries in the Europe and Central Asian region to mainstream climate adaption into agricultural policies, programs and investments.

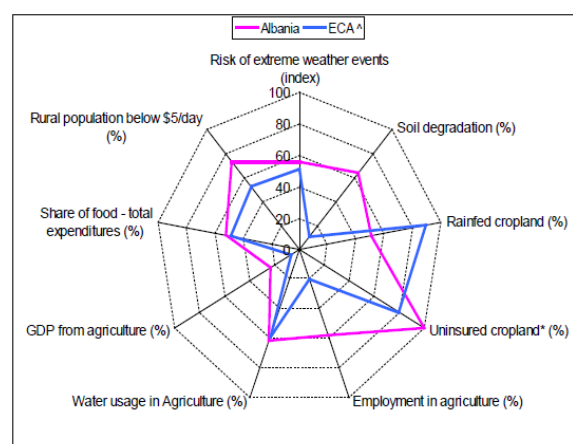
In coordination with the Uzbekistan Ministry of Economy, Ministry of Agriculture and Water Resources and Ministry of Environment, an awareness raising and consultation workshop on reducing vulnerability to climate change in Uzbekistan's agricultural systems was held in May 2010. Ongoing, analysis and economic modeling to assess both the climate change impacts and potential adaption measures for a range of farming, livestock and production systems across three agro-ecological zones is also being conducted in Uzbekistan. This analysis can be used to develop an agriculture and climate change impact assessment and menu of adaption options which will highlight the physical, economic and social impacts of climate change on the agriculture sector and identify adaptation priorities for investments, capacity development and policy improvement. This analysis will be disseminated at a high-level National Dissemination and Consensus Building Conference to be held in Uzbekistan in early 2011. This will be followed by a regional knowledge exchange conference wherein experts from Uzbekistan can share their experience and results and learn from experts in other participating countries.



## Albania Country Note: Agriculture, Food Security and Climate Change

Albania is located in south-eastern Europe, on the western side of the Balkan Peninsula, bordering the Adriatic and Ionian Seas. It has a surface area of 28,745km<sup>2</sup> with 77 percent of the country's territory comprised on hilly or mountainous land.<sup>52</sup> Albania has high rates of soil degradation and powerful, highly erosive river flows, given the terrain and change in relief from the mountains to the coast.

It has an estimated population of 3.2 million, with 53 percent of the population living in rural areas. Between 1998 and 2007, Albanian GDP expanded at an average rate of 6.8 percent per annum.<sup>53</sup> GDP for 2007 was US\$10.8 billion, while GDP per capita was US \$ 3,405.<sup>54</sup>



Note: Employment in agriculture (% of total employment)\*; Rainfed cropping (% of cropland)\*; Water usage in agriculture (% of total annual freshwater extraction)\*; Uninsured cropland (Estimate); Soil degradation (% of total land)\*\*; Risk of extreme weather events (additional 1.20 year events 2070-2100 Vs. 1961-1990)\*\*\*; Share of food – % of total expenditures \*\*\*\*; GDP from Agriculture\*; Rural population below \$5/day\*\*\*\*; Sources: \*World Development Indicators 2008; \*\* FAO AGL 2005; \*\*\* Baettig, M. et al., 2007. \*\*\*\* ECA Databank. <sup>Δ</sup>ECA statistics come from transitions and developing economies of Eastern Europe and Central Asia, where available

### Agriculture and its Role in the Economy

Agriculture is still the backbone of the Albanian economy, with more than half the population of Albania living in rural areas, 20.7 percent of the country's GDP being derived from agricultural activities, and 58.3 percent of the population deriving their livelihood from climate sensitive sectors like agriculture, forestry, and fisheries.<sup>55</sup> 75 percent of the total land area is used for agricultural production including crops, pastures, and forest lands.<sup>56</sup> The flatter, coastal areas are dominated by crop production, while forestry and pasture dominate the mountainous zones in the east of the country. Furthermore Albania's rivers still provide over 90 percent of its electricity, though this percentage is decreasing as rainfall becomes less predictable (see below) and demand increases.

Livestock (including the value of products grown and fed to livestock) account for 56 percent of the total value of production, fruits 14 percent, and crops 30 percent. Of these, the value of vegetables is more than twice that of cereals, which are grown on drier and less fertile land.

From 2000 to 2007 the value of agricultural products increased from €890 million to 1118 million, while that of agro-industry increased from €11 million to 388 million. Albania's net food imports have grown through the decade as incomes have grown, and totaled €450 million in 2007.

Albania's comparative advantage is likely to lie in seasonal fruits, vegetables and livestock products. Its forests and pastures also play a key role in landscape and watershed conservation, as well as in provision of fodder and fuel. The contribution of cereals, grown for subsistence and historically for self sufficiency, is likely to continue to decline.<sup>57</sup>

### Climate Change Projections

The mean temperatures in the mountainous zone range from 4-12°C, while in the coastal plain, they range between 12-18°C. Annual mean precipitation in the lower rainfall band

running east-west across the central and southern areas of the country is 600-1000mm. In the mountainous region in the north, precipitation averages up to 3000mm.

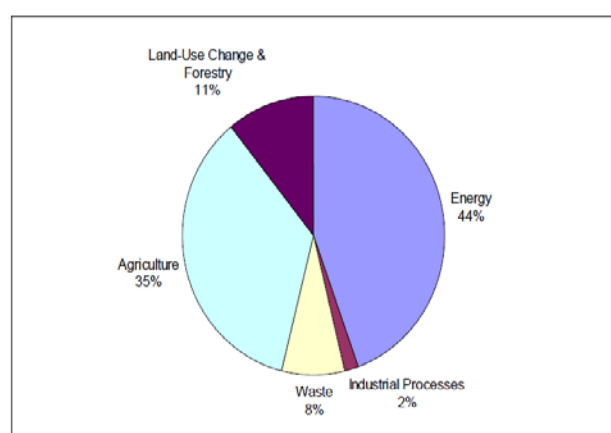
Historical data indicate that Albania has become warmer and drier, and projections for the period from 2030-2049 compared to 1980-99 indicate that Albania will be exposed to<sup>58</sup>:

- A 2°C increase in mean annual temperature for winter and summer
- A decline in mean precipitation of 8 percent
- A decline in annual water availability for crops (runoff) by 28 percent
- An increase in the number of consecutive dry days and decrease in the number of frost days
- An increase in the Heatwave Duration Index of 20 days.

### Contribution of Agriculture and Land Use Change to Greenhouse Gas Emissions

With potential adverse changes in temperature, precipitation, and the frequency of extreme events, existing inequalities between rich and poor populations and vulnerable communities within Albania will be exacerbated and place a strain on institutions, food supply and rural growth. Across the country there will be a significant variation in vulnerability, with areas presently under marginal rain-fed production having less adaptive capacity and becoming increasingly riskier compared with more productive areas and irrigated agricultural land.

Percentage of Greenhouse Gas Emission by CO<sub>2</sub> equivalent, by sector (2000)



Source: Climate Analysis Indicators Tool (CAIT) Version 6.0. 2009.. World Resources Institute, Washington, DC.

35 percent of greenhouse gas emissions by CO<sub>2</sub> equivalent come from agriculture and another 11 percent from land use change and forestry. Agriculture accounts for 77 percent and 91 percent of Albania's methane and nitrous oxide emissions respectively.<sup>59</sup>

### Main Threats and Opportunities Posed by Climate Change to Agriculture and Food Security

With total annual rainfall and runoff declining, river flows will substantially decrease and place pressure on water resources, increasing conflicts between agriculture and other water uses. Combined with increased temperatures, and drought risk, the threat to crop yields is clear, especially for summer crops. Changing climatic conditions may lead to problems associated with an array of agronomic issues including changes in soil drainage patterns leading to salinity, damage to soil structure reducing land productivity, and exposure to new pests and diseases that challenge existing plant and animal genetics and management.

Changes in temperature, precipitation, and water scarcity will affect cropping conditions as well as the livestock sector in terms of animal health, nutrition, husbandry, and livestock-related infrastructure. Changing climatic conditions will adversely affect fodder and forage production and rangeland biomass, which could lead to volatile feed prices, increased competition for community grazing lands, and increased water scarcity. Given these constraints, there could be shifts in production from intensive to less intensive livestock

systems and an increased risk of losses for small-scale producers, who comprise the majority of the rural population in Albania.

Projections of climate change impacts on crop yields vary but on average the results from the different models are negative. There is the opportunity to develop agricultural systems that are resilient and highly adaptable to the range of conditions that may present themselves.

Thus, the downside risks to the agriculture sector are significant under climate change projections while upside opportunities from the projected changes seem limited. Hence, the focus should be on developing effective adaption options for a range of farming and livestock systems across the different agro-ecological zones, such as afforestation and setting up barriers to protect arable land, xerophilic crops for the higher temperatures and scarce water, improved soil management and agronomy, improved irrigation schemes, livestock management, etc. To mitigate agricultural emissions, potential strategies for the agricultural sector include increase of feed digestibility and reduction of overgrazing pressure on marginal lands to improve feed quality.

### **Government Strategies for Agriculture, Food Security and Climate Resilience**

**Inter-Sectoral Rural Development Strategy of Albania (2007-2013)** outlines the priorities for rural development policy in the medium term. The strategy was prepared by the Ministry of Agriculture, Food and Consumer Protection and focuses on strengthening agriculture, agro-food chain and rural communities through enhancing competitiveness of the sector via structural reforms. It does not explicitly address climate change.

**Albania Strategic Policies for a more Competitive Agriculture Sector (2007)** is a World Bank report that outlines policy options and strategic challenges that face the agricultural sector. The report provides a solid basis for future analysis that incorporates climate change exposure.

### **Programs to Support Climate-Smart Agriculture: Successes and Challenges**

As in many other countries programs are ongoing which contribute to “climate smart agriculture” even if this was not the explicit intention.

**Disaster Risk Mitigation and Adaptation Project (2008-2012)** has a budget of US\$3 million and aims to strengthen institutional capacities (a) to reduce Albania’s vulnerability to the natural and manmade hazards; and (b) to limit human, economic, and financial losses due to these disasters. One component of the project specifically will work to improve the availability of hydrometeorological information to Albania’s key weather dependent sectors.

**The Natural Resources Development Project (2005-2010)** has a budget of US \$15 million and aims to establish or maintain sustainable, community-based natural resource management, including reforestation and pasture restoration, in about 218 communes in upland and mountainous erosion-prone lands. This will lead to enhanced productivity and incomes derived from sustainable resource management, reduced soil degradation, improved water management, conservation of biodiversity, and strengthened public sector management of these resources. The project also includes co financing from the biocarbon fund, with payments for sequestration from reforestation made to local communities, funding from GEF through the land degradation window, and Swedish government co financing. Pastures and

forests in this area are key sources of fodder for livestock and their sound management is thus key to rural livelihoods and to livestock productivity.

**Europe and Central Asia Regional Program on Reducing Vulnerability to Climate Change in Agricultural Systems:** This three year program of analytical and advisory activities is designed to better determine the potential impacts of climate change on the agricultural sector in four countries, including Albania. Work is being carried out with key stakeholders to develop practical recommendations on the actions these countries can take to increase the resiliency of their agricultural sectors in the face of climate change. The overall objective of the program is to enhance the ability of countries in the Europe and Central Asian region to mainstream climate adaption into agricultural policies, programs and investments.

In coordination with the Albanian Ministry of Agriculture, Food and Consumer Protection and Ministry of Environment, Forestry and Water Administration, an awareness raising and consultation workshop on reducing vulnerability to climate change in Albania's agricultural systems was held in May 2010. Ongoing, analysis and economic modeling to assess both the climate change impacts and potential adaption measures for a range of farming, livestock and production systems across three agro-ecological zones is also being conducted in Albania. This analysis will culminate in the development of an agriculture and climate change impact assessment and menu of adaption options which will highlight the physical, economic and social impacts of climate change on the agriculture sector and identify adaptation priorities for investments, capacity development and policy improvement. This analysis will be disseminated at a high-level National Dissemination and Consensus Building Conference to be held in Albania in January 2011. This conference will be followed by a regional knowledge exchange conference where experts from Albania can share their experience and results and learn from experts in other participating countries.

A recently closed **Agricultural Services Project** aimed to create an environment conducive for rural income growth by addressing key constraints faced by Albania's emerging small-holder farmers in agricultural production, trade, and the functioning of land markets. It supported revitalization of the seed industry, land title registration, market rehabilitation and technological improvements, focusing on horticulture and livestock. And improved irrigation and water resource management have also played a key role in Albania's rural development strategy. Specifically the recent water resources project has addressed dam safety, irrigation and drainage restoration, river bed restoration and strengthening of water users associations to help reduce vulnerability to weather related risks and support production of high value crops.

Albania's "climate smart agricultural" strategy is likely to focusing on reducing vulnerability on the one hand (through watershed management, irrigation, drainage and flood management, improved climate information and eventually weather based risk instruments) and increasing incomes and resilience on the other, through creating an enabling environment for production and processing to enhance value added of competitive products, mostly vegetables, fruits and livestock products. The EU accession process also provides opportunities in both of these areas.

## Relevant Reference Material

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